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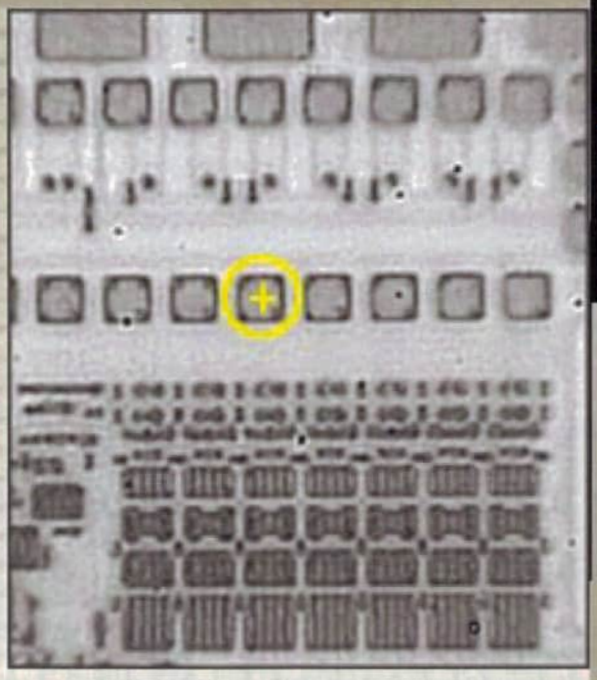

EmiScope®-II
EmiScope®-IIt
Users Guide

February, 2005
R 7.0

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PREFACE

The safety guidelines for the equipment in this manual do not purport to address all the safety issues of the equipment. It is the responsibility of the user to establish appropriate safety, ergonomic, and health practices and determine the applicability of regulatory limitations prior to use. Potential safety hazards are identified in this manual through the use of words Danger, Warning, and Caution, the specific hazard type, and visual hazard alert icons.

Hazard Levels

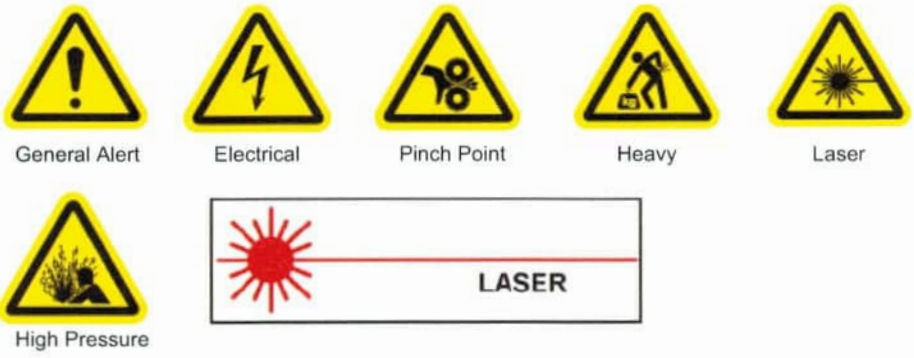
DANGER: Indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury. This is limited to the most extreme situations.

WARNING: Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.

CAUTION: Indicates a potentially hazardous situation which, if not avoided, could result in minor or moderate injury. It may also alert users against unsafe practices.

NOTE: Indicates a statement of company policy (that is, a safety policy or protection of property).

Visual Hazard Alert Symbols



Support Services

If you have questions about your equipment, please review this booklet first. If you cannot find the answer, contact Credence. To receive information on new products and product support, contact Credence at 011-650-605-0082.

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CHAPTER 1

EmiScope-II System Description

This chapter provides a brief description of the EmiScope-II tool and its operation. It also includes important safety information associated with EmiScope-II operation. All personnel should read the safety chapter first prior to contact with the EmiScope-II system. It describes all known hazards associated with EmiScope-II operation and how to safely use the system.

How Optical Diagnostics Work

When the state of a CMOS gate switches, carriers (electrons for nMOS and holes for pMOS) flow from one part of the circuit to another through the channel of one or more transistors. In a small region of the channel, the electric fields can be very strong and some of the carriers can pick up a great deal of kinetic energy.

These energetic carriers, also known as hot carriers, lose energy as they flow to the drain of the transistor. Some of this energy can be lost in the form of light, or photon, emission. The Credence EmiScope-II takes advantage of intrinsic photon emission to make picosecond timing measurements through the backside of an integrated circuit.

The probability of the transistor emitting a photon is much less than one, so the test loop must be repeated many times. Photons are collected and time stamped with the time they were detected relative to some point in the test loop. After many test loops, enough photons are collected to produce a peak of photon emission. This peak is then analyzed to determine the time at which the transistor switched.

By repeating the photon collection process at each transistor of interest, an electrical signal can be traced with confidence through the circuit under test.

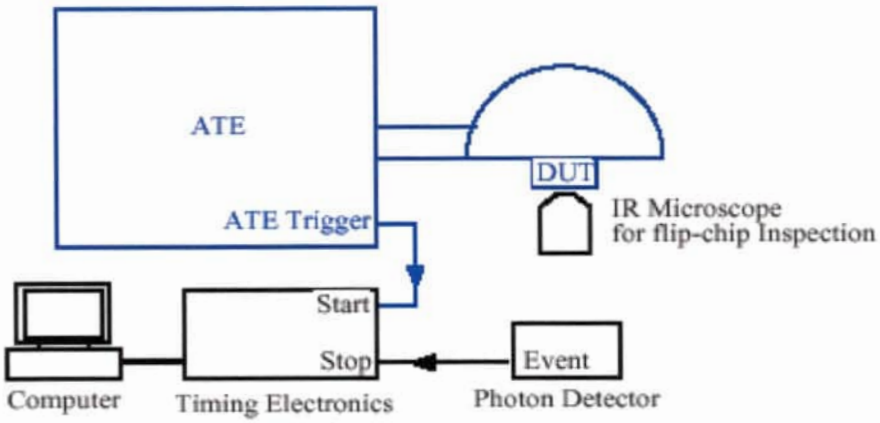
EmiScope-II

EmiScope-II is a next generation integrated dynamic emission tool for silicon backside semiconductor device diagnostics. It is an add-on tool for use with chip-testing automatic test equipment (ATE) enabling internal non-invasive probing of an active integrated circuit. It consists of:

- An infrared microscope for imaging through the backside of an integrated circuit.
- A configurable turret for using various microscope lenses.
- A photon-counting detector to detect dynamic light emission from an integrated circuit.
- A data acquisition system that collects the time of the photon emissions relative to a trigger signal supplied by an ATE system.
- A computer for processing and displaying the acquired dynamic-emission data.
- A laser DUT alignment system for use with Solid Immersion Lens kits.

Figure 1 provides a schematic diagram of the Credence EmiScope-II system mated with an ATE system. The ATE exercises a device under test (DUT) while the infrared (IR) microscope captures its dynamic optical emission and focuses it onto a photon detector. Photon events from the detector are passed to the timing electronics, which times the arrival of all photons relative to a reference timing signal supplied by the ATE. A computer processes the timing data and displays processed data showing a scope-like trace of the photon emission rate versus time.

FIGURE 1. Credence EmiScope-II with ATE



The ATE system test head is docked with the EmiScope-II. A 50 ohm coaxial cable provides the trigger signal from the ATE to the EmiScope-II timing electronics.

The EmiScope-II infrared microscope images the active elements of the flip-chip DUT by looking through the back side of the DUT. The microscope is mounted on three-axis mechanical stages that allow navigation around the DUT. A three-point alignment procedure is performed in order to obtain the proper transformation coordinate system between the database chip coordinates and physical stage coordinates. Once aligned, any region of the DUT can be easily located by entering the device coordinates.

The EmiScope-II system is equipped with a Microsoft Windows based computer, keyboard and display monitor. This computer is used to run the software applications to control the acquisition, processing and displaying of the dynamic-emission data. The EmiScope-II control software is a single application which operates in two user selectable modes.

- Navigation mode is used to move and align the EmiScope-II stages, view a real-time image of the DUT, and communicate with the CAD navigation software.
- Acquisition mode is used to acquire and analyze EmiScope-II photon collection data.

Event Logger runs in the EmiScope-II software background and records events generated while using the EmiScope-II system.

Maintenance and Service Package

The EmiScope-II is composed of subsystem modules and replaceable devices. System service is performed on-site by the removal and replacement of the failing subsystem or device. All service and maintenance for the EmiScope-II should be performed by a trained Credence employee only. There are no user serviceable subsystems, modules, or devices in the EmiScope-II.

FIGURE 2. EmiScope-II System Overview

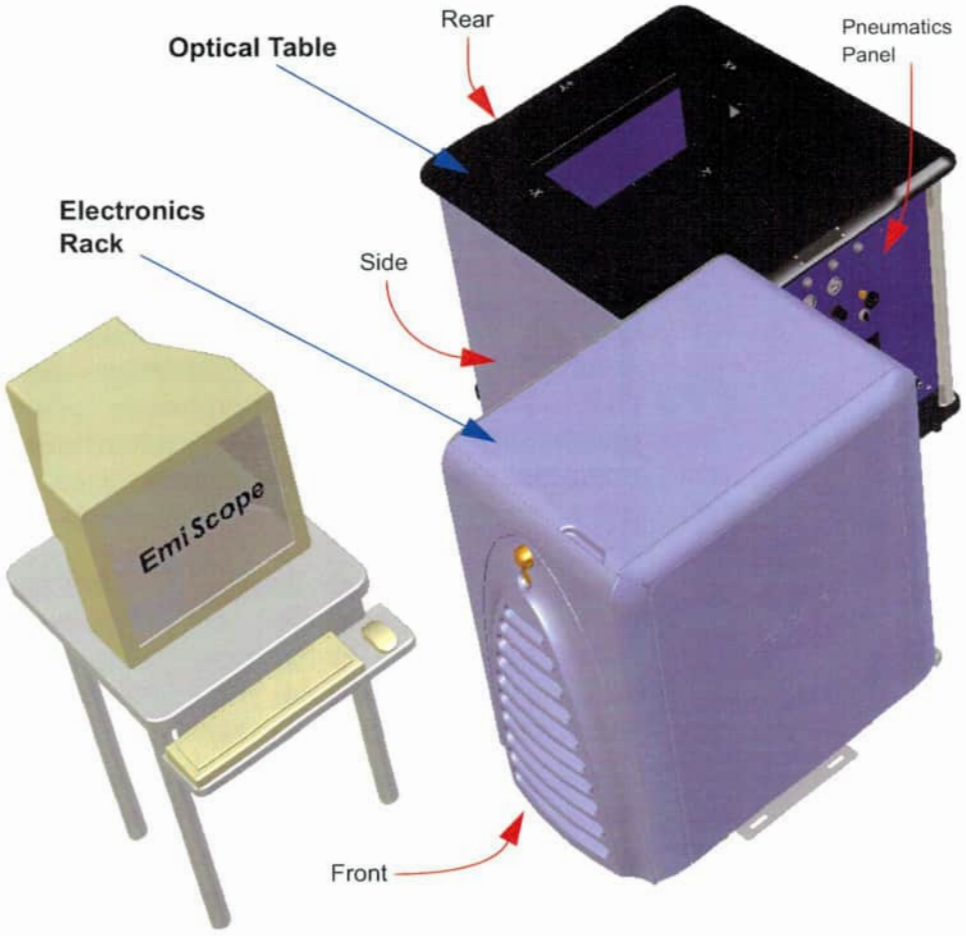
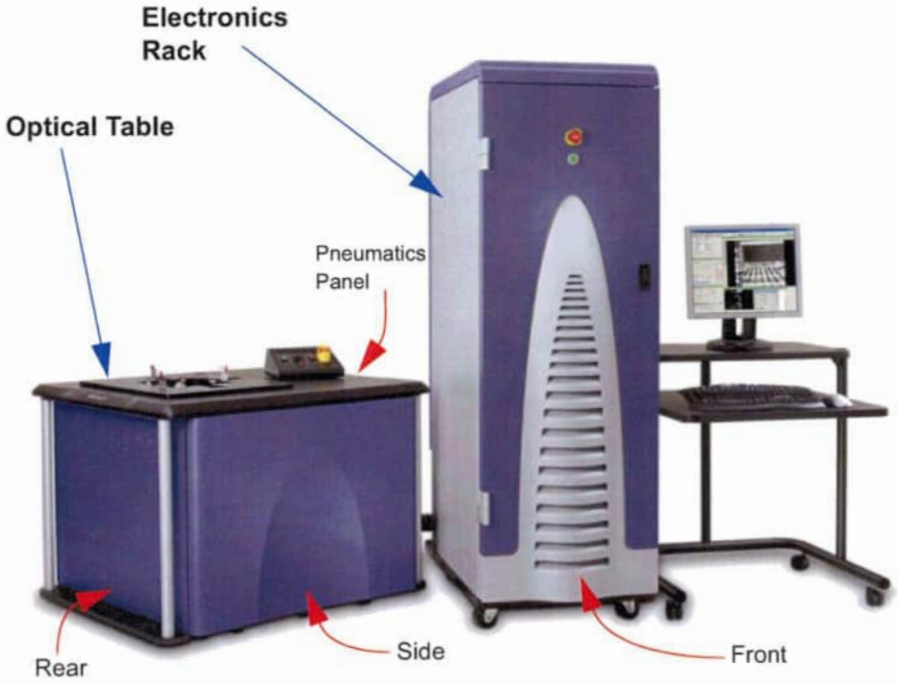


FIGURE 3. EmiScope-II*t* System Overview



CHAPTER 2

Safety

The EmiScope-II is an inherently safe system. This chapter contains all known hazards associated with EmiScope-II operation and should be read by all personnel who could come into contact with this product. Each hazard statement starts by advising of the hazard, followed by the specific risk or injury result which might occur; and clearly explains how to avoid the hazard. In addition, visual hazard alerts are attached to the EmiScope-II near the hazard to alert and inform the viewer.

Safety Features

The EmiScope-II is designed with various safety features. This section describes important information on these features.

Safety Compliance Program

No hazardous material is used, or waste generated during operation and maintenance of the equipment. No solid wastes result from operation, maintenance, or servicing the equipment.

Visual Hazard Alert Labels

sign A visual communication system that advises the observer of potential hazards that can cause accidental bodily injury, death, or property damage. A sign provides safety precautions, evasive actions, or other directions to eliminate or reduce the hazard to an acceptable level. [SEMI S1-90] Examples are safety sign, visual hazard alert, and alert.

ANSI safety labels are placed throughout the EmiScope-II system to identify potentially hazardous locations. Table 1 contains all of the labels placed on the EmiScope-II, their location on the system, and a description of the hazard to avoid. Credence recommends that you carefully review this table,

and read the entire Safety section before installing, operating or servicing the equipment.

TABLE 1. ANSI Safety Labels

Label	Description and location
	This label warns of possible contact with hazardous voltages within this location. This label is applied to the rear of the electronics rack, top of the system power distribution unit(PDU), and the back of the system controller. To avoid possible electric shock, lock-out and tag-out power to the EmiScope-II prior to servicing the PDU or system controller. Failure to observe this precaution could result in serious injury or death

TABLE 1. ANSI Safety Labels (Continued)

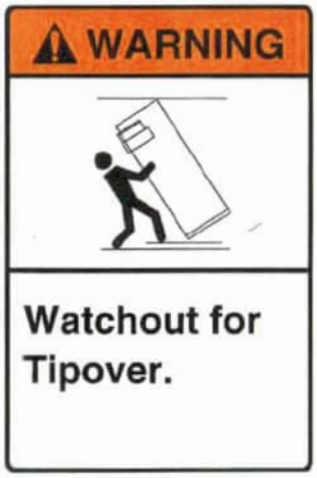
Label	Description and location
	This label warns of a potential hazard due to heavy load. Tasks involving heavy objects include removing and replacing the water chiller and the optical bench. Improper ergonomic handling may result in injury. To avoid injury to personnel or damage to equipment, use two hands and/or two people to lift the assembly or to perform the task. Failure to observe this precaution could in injury to personnel or equipment damage. This label is applied to the rear and both sides of the optical table enclosure.
	This label warns of a potential tip over hazard. There are two of these labels on the EmiScope-II, applied on each side of the electronics rack. Improper ergonomic handling may result in injury. To avoid injury to personnel or damage to equipment, use proper lifting and handling techniques when working on the system. Failure to observe this precaution could in injury to personnel or equipment damage.

TABLE 1. ANSI Safety Labels (Continued)

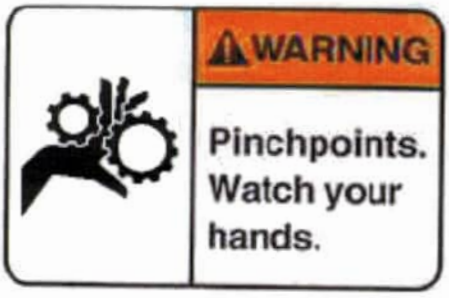
Label	Description and location
	This label identifies a component that must be locked-out and tagged-out prior to servicing. A lockout is a method of keeping equipment from being energized and endangering workers. The energy-isolating mechanism is placed in the safe position and a written warning is attached to it. Lock-out/tagout is available for all hazardous energy sources and pneumatic panel. This label is applied to the pneumatics panel on the front of the optical table enclosure.
	This label warns of potential pinch points when docking the EmiScope-II to an automated test system. There are four of these labels placed in the middle of each side on the table top edge to identify potential pinch points. Never place hands inside the EmiScope-II tabletop opening when docking/undocking ATE. Failure to observe this warning could result in injury to personnel or equipment damage. The XYZ stage in the EmiScope-II system should be at the home position during ATE docking/undocking. Failure to place stages in the home position could result in personal injury or equipment damage.

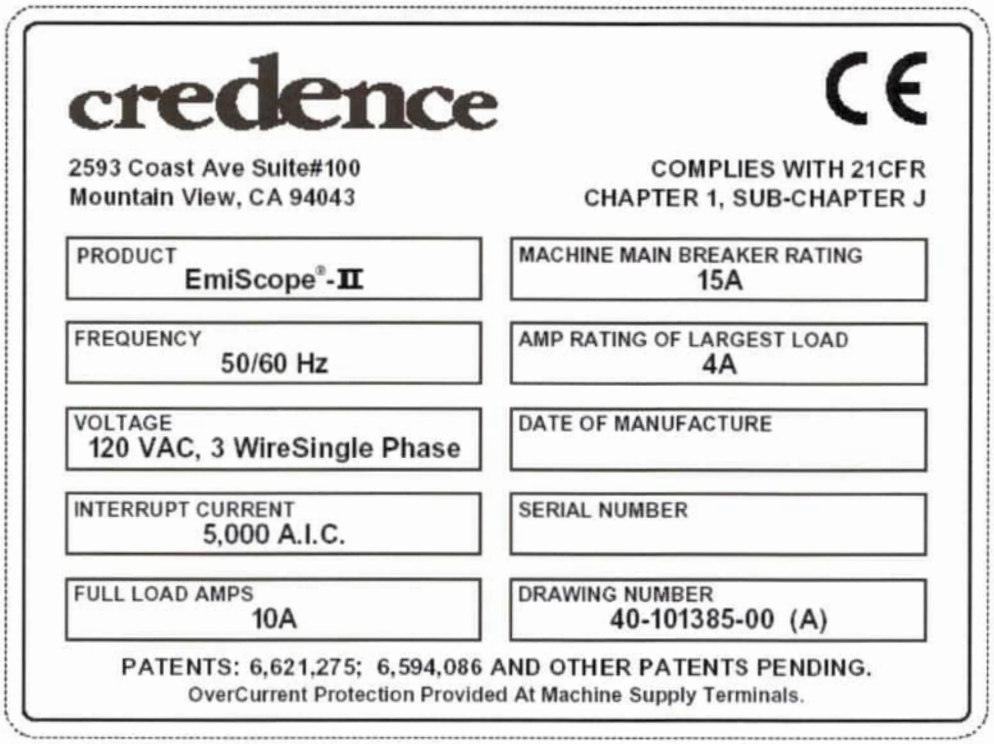
TABLE 1. ANSI Safety Labels (Continued)

Label	Description and location
	This label warns of a pressurized device. Air pressure should be released before servicing. There is one of these labels placed on the EmiScope-II pneumatic panel. The system should not be operated without system air pressure. We recommend normal system shutdown procedures in the event of a total loss of system air pressure.
	These labels warn of an invisible, enclosed laser source. The enclosure should not be opened without removing the laser power source. Caution - Use of controls or adjustments or performance of procedures other than those specified herein may result in hazardous radiation exposure. One of these two labels is applied to the optical bench - above the tilt-tip alignment laser, inside the optical table enclosure.

TABLE 1. ANSI Safety Labels (Continued)

Label	Description and location
	The EmiScope-II contains one of this type of ground label. This label is located on the cross section of the bus bar, a solid metal uninsulated conductor. This label identifies the location of the common, grounded conductor to which various parts of the system are returned for a complete circuit.
	This label identifies the electrical connection to the ground for a component. There are fourteen of these labels applied to the EmiScope-II. Each label is located next to the ground lug of the PDU, PC, NIM bin, water chiller, XYZ stage controller, optical table, electronics rack, and bracket between the electronics rack and the optical table.
	This label identifies the physical earth ground current. This location identifies where the electric current flows into the earth through the EmiScope-II. There is one of these labels on the EmiScope-II system, located next to the PDU ground lug.

FIGURE 4. EmiScope-II Rating Plate



Safety Interlocks

The EmiScope-II contains safety interlocks to protect personnel from exposure to potentially hazardous situations during system operation, and prevent damage to the system components.

- The front, rear, and sides of the electronics rack are enclosed requiring a tool to open.
- The optical table enclosures have magnetic interlocks for the side and rear panels labeled for maintenance access.
- The pneumatic panel main air valve switch has a keyed lock.
- The table top has a switch interlock to prevent access to energized mechanisms within the table frame.

Interlock Status Messages

These are the interlocks:

- Active: The machine covering panels have been removed.
- Active: The DUT Interface is removed.
- Active: The drip pan has a liquid present (water) sensor.
- Active: The water chiller has a low water sensor.
- Active: The laser source power is removed.

When any of these interlocks are activated, the EmiScope-II system will be disabled as a result.

WARNING: Do not defeat or override the interlock. Overriding or defeating the Interlock will expose service personnel to hazardous conditions.

Stage Interlock

If the high magnification lens objective contacts an object, an alarm will sound. The control pad and the stages will be locked out until the stage interlock switch is cleared.

To clear a stage interlock alarm, hold down the Stage Override button on the Control Pad while moving the stage away from the area of contact. Once the stage is away from the area of contact, the stage alarm will cease, and normal system operation can proceed. For more information on how to clear the interlock alarm see "Clearing a Crash" on page 29.

Panel Interlocks

The EmiScope-II optical table panels are equipped with interlocks that disconnect AC power to the system if activated. The optical table rear panel and side panels interlocks are triggered when any of the side/rear panels are removed, and the entire system, except for the EmiScope-II PC, will shut down.

Periodic tests to the safety interlock systems should be performed every 6 months to ensure their proper operation.

In addition, the maintenance doors on the front and rear of the electronics rack are secured. Opening these doors requires a special tool.

TABLE 2. EmiScope-II Interlocks

Interlock	Location	Trigger	Hardware Response
DUT Interface	Table top	Remove Device Under Test	De-energizes laser, Z stage moves to home position, XYZ stages and turret are de-energized.
Magnetic Reed Switches	Front and Side Panels of Optical Table	Remove Panels	De-energizes entire system, (except PC), stops motion of stages, turns off fluid flow, (chiller).
Float Switch	Drip Pan	Water fills drip pan	De-energizes entire System (except PC) Turns off Chiller to stop water flowing.
EMO Buttons	System Controller and Front Door of Electronics Rack	Press EMO Button	De-energizes entire system, (except PC).
Relay	PDU	EMO Button	De-energizes entire system, (except PC).
Float Switch	Water Chiller	Low water level	De-energizes entire System (except PC) Turns off Chiller to stop water flowing.

Electrical Safety

The EmiScope-II is designed to protect operation and maintenance personnel from exposure to dangerous electrical circuits. Electrical safety features include, but are not limited to the following:

- Electrical enclosure doors can only be opened with an appropriate opening tool.
- Interior guards and shields are provided over terminals that have in excess of 30V when energized.

- Wiring sizes, connections, and color codes meet the requirements of the National Electric code.
- Hazard alert labels appear on the exterior of equipment, which may contain a hazard.

To prevent exposure to energized electrical parts, whenever possible, lockout all electrical energy sources supplying energy to the area or components being serviced before performing maintenance (see "Lockout/Tagout" on page 21). Special care must be taken whenever internal components or wiring are exposed while performing maintenance tests.

Emergency Machine Off (EMO)

The EmiScope-II has two or three Emergency Machine Off (EMO) buttons, based on system type. The EMO is used to bring the system to a safe shutdown condition in an emergency to ensure the safety of personnel and equipment. It is designed to be used when personnel and/or equipment are in danger from mechanical crashes, such as objective crashes, turret obstructions, stage obstructions, and aberration ring obstructions.

The EMO buttons are large, red mushroom shaped buttons with a yellow background. One EMO is located on the front door of the electronics rack, and the second EMO is located on the front panel of system controller inside the electronics rack. On the EmiScope-II*t*, a third EMO is located on the user control pad. The EMO is a push activated switch. When an EMO button is pressed, the EMO circuit is activated and all components are placed in a safe shut down condition, then the entire system is de-energized. See Figure 5 on page 18.

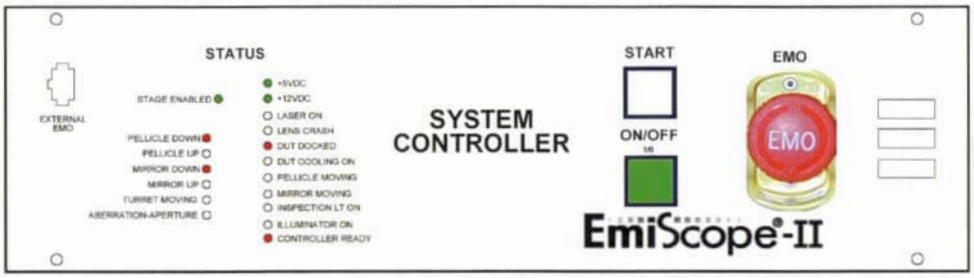
NOTE: The EMO circuit must be used only in Emergency Situations. Whenever possible, use normal system shutdown procedures rather than using the EMO circuit to power down.

NOTE: Pressing an EMO button does not remove power to the EmiScope-II PC.

Pressing an EMO button will cause a loss of all information stored in the detector and controller system. Data stored in the data acquisition buffer and stage controller will be lost and must be recovered during initialization.

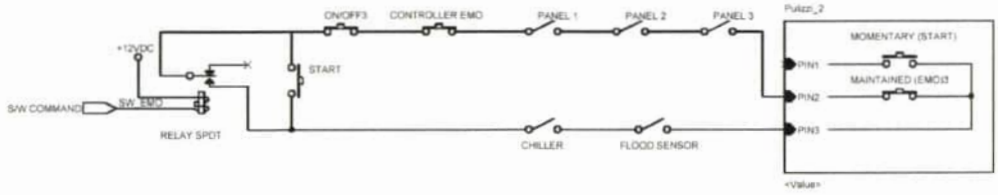
If pressed, an EMO button must be reset prior to restoring power. Pull the EMO button out to reset it.

FIGURE 5. EMO Button on EmiScope-II Controller Front Panel



You can reset power by pulling the EMO button out and pushing the start button on the system controller. Use EMO buttons for emergencies only, not for normal shutdown procedures.

FIGURE 6. EmiScope-II EMO Block Diagram



STOP Button

A STOP button is provided to protect the DUT and system hardware from stage or user failures. It is a red, push button located on the User Control Pad. Pressing the STOP button removes power from the stages and the turret. However, power is still present in the EmiScope-II system. No information is lost when the STOP button is pressed. However the stages may need to be re-initialized.

FIGURE 7. STOP Button on EmiScope-II Control Pad

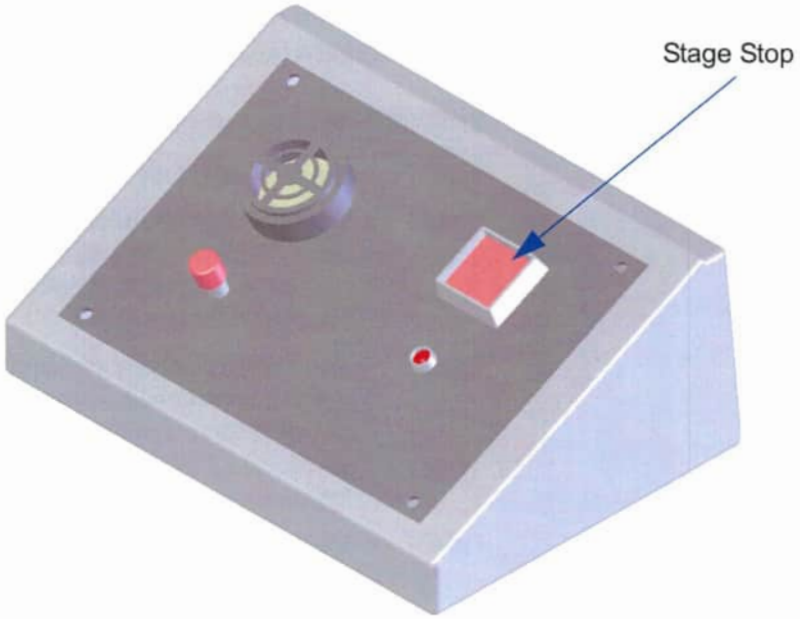
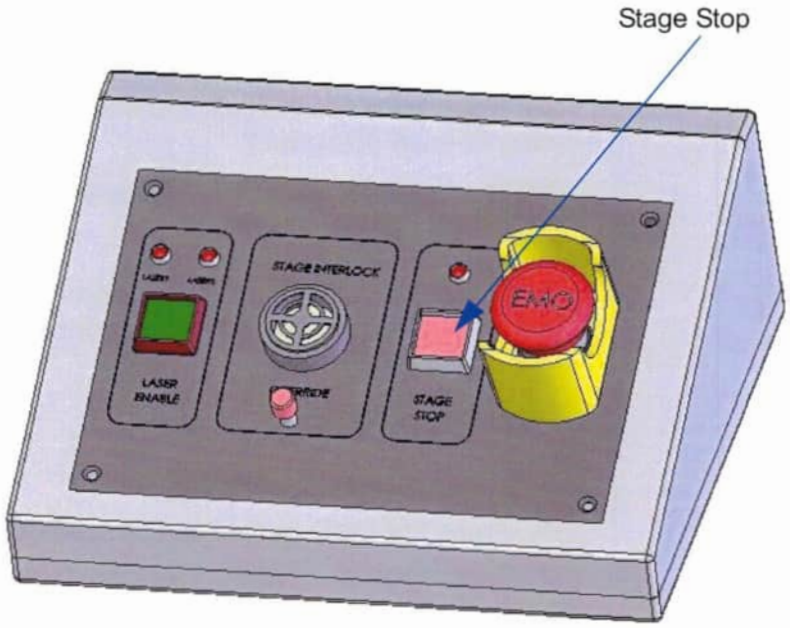


FIGURE 8. STOP Button on the EmiScope-II*t* Control Pad



Energized Electrical Work Types

The Safety Guidelines for Semiconductor Manufacturing Equipment (SEMI S2-0703) defines four types of electrical work. These tasks are:

TABLE 3. Maintenance Task Classifications

Type 1	Equipment is fully de-energized.
Type 2	Equipment is energized. Energized circuits are covered or insulated. Type 2 work includes tasks where the energized circuits are or can be measured by placing probes through suitable openings in the covers or insulators.
Type 3	Equipment is energized. Energized circuits are exposed and inadvertent contact with uninsulated energized parts is possible. Potential exposures are no greater than 30 volts root mean square (RMS), 42.2 volts peak, 60 volts DC or 240 volt-amperes in dry locations.
Type 4	Equipment is energized. Energized circuits are exposed and inadvertent contact with uninsulated energized parts is possible. Potential exposures are less than 30 volts rms, 42.2 volts peak, 60 volts DC or 240 volt-amperes in dry locations. Potential exposures to radio-frequency currents, whether induced or via contact, exceed the limits in Table A5-1 of Appendix 5 of SEMI S2-0703.

The EmiScope-II system is designed to prevent exposure to electrical energy during Type 1 or Type 2 maintenance tasks. The applicable electrical work types are indicated in the safety information provided at the beginning of each procedure.

NOTE: There are no Type 3, Type 4 or Type 5 maintenance tasks associated with the EmiScope-II system.

Any services that require the system to be locked out (Type 2 tasks) should only be performed by trained personnel.

Electrical Shock

- **In case of electrical shock,**

1. Press the EMO button on the EmiScope-II controller. See Figure 5.
2. Disconnect the main power cord from the EmiScope-II Power Distribution Unit.

3. Switch the main circuit breaker off or down.

♦ **To recover the system,**

1. Find, verify and fix the failure.
2. Reconnect the main power cord.
3. Power up the system by switching the main circuit breaker on or up.
4. Pull out the EMO.
5. Press the ON button located on the EmiScope-II controller.
6. Press the START button located on the EmiScope-II controller.

Lockout/Tagout

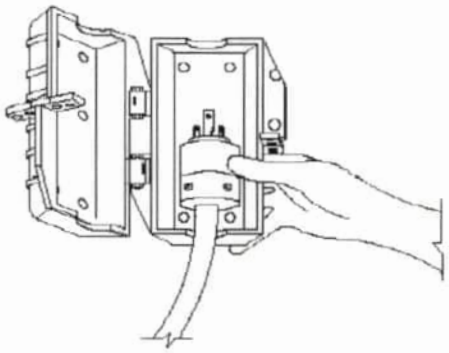
We recommend that you carefully follow the lockout/tagout procedures before servicing the EmiScope-II. These tasks must only be performed by qualified and authorized service technicians.

A lockout is a method of keeping equipment from being energized and endangering workers. Lockouts use the following methods:

• A disconnect switch, circuit breaker, valve, or other energy-isolating mechanism is put in the safe or off position, or

• A device is placed over the energy-isolating mechanism to hold it in the safe position.

FIGURE 9. Plug Lockout Device



In a tagout, the energy-isolating mechanism is placed in the safe position and a written warning is attached to it.

Lockout and tagout all of the following potentially hazardous energy sources:

- Lockout on main disconnect of power distribution unit using lockout/tagout.
- Lockout on main disconnect of system controller using lockout/tagout.
- Lockout on main disconnect of pneumatic panel using main air valve switch key.

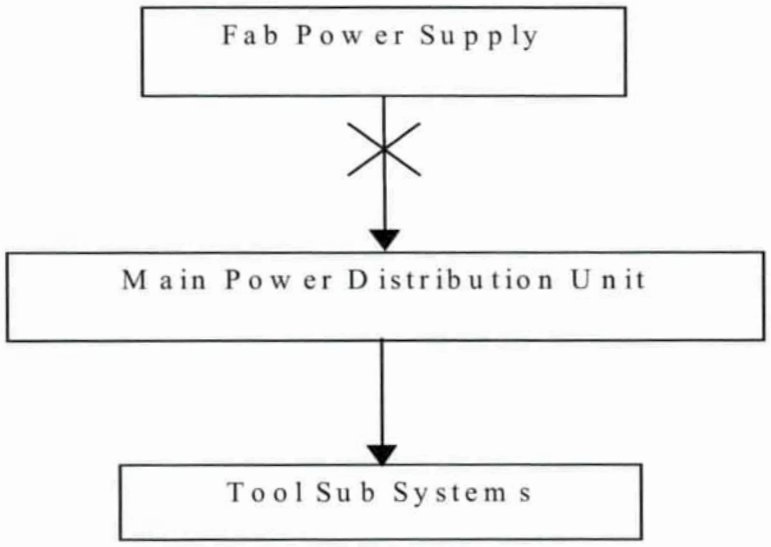
When the power distribution unit is opened at the main disconnect, all incoming electrical power is removed from the equipment on load side of disconnect. The disconnect also has energy Isolation (LOCK-OUT) capabilities.

There is a MAIN over current protection device rated for 5000 rms AIC.

Fab Lockout/Tagout

A fab lockout/tagout procedure is performed when the EmiScope-II system is installed, moved or whenever Fab power is connected to the EmiScope-II system. This procedure is required in every service procedure involving the Main Power Distribution Unit. The following diagram illustrates the lockout/tagout required for fab power connection. The Main disconnect is in a plain sight and easy access from the user station.

FIGURE 10. Fab Power Lockout/Tagout



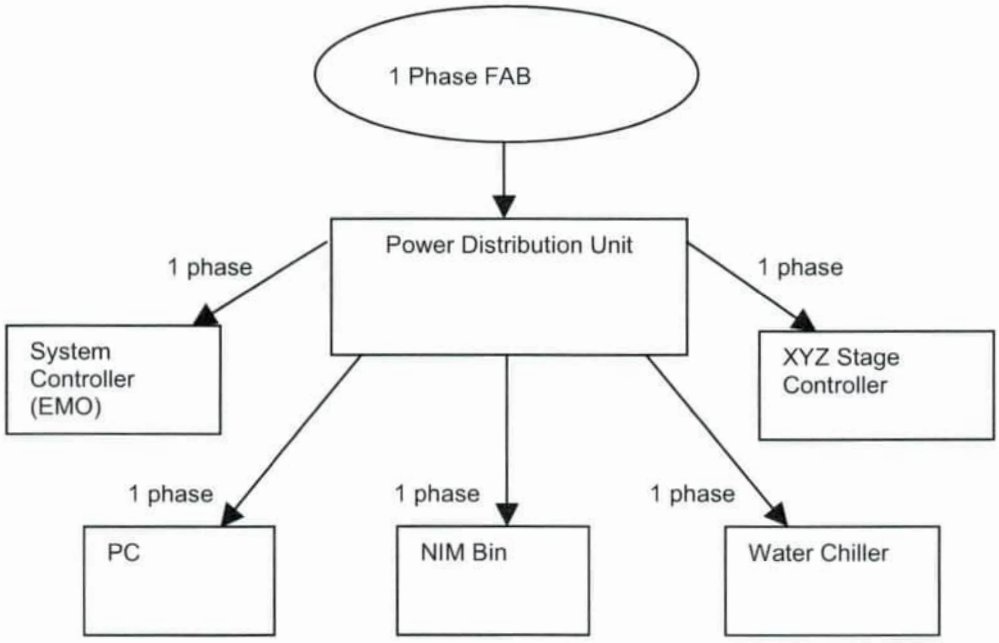
Powering Up the Power Distribution Unit

Before applying power to the Power Distribution Unit (PDU) verify that:

- The Selector Switch on the PDU is in the Local or Remote mode.
- The circuit breaker is in the "ON" position.
- The EMO Button on the front of system rack is in "OFF" position.

Turn on the PDU by first pushing the "ON" button of the system controller. Then hold down for three seconds the "START" button on the system controller. The power lights on the PDU front panel illuminate when power is applied.

FIGURE 11. General Electricity Block Diagram



Hazardous Energy Isolation

There are potentially hazardous energy sources present when operating the EmiScope-II, which present a threat to personnel safety and must be acknowledged whenever performing maintenance activities on the system.

Hazardous electrical voltages up to 120 VAC are present inside the power supply assemblies, PDU, electronic compartment, water chiller, and other labeled areas. If the covers on these assemblies remain closed the balance of the system and its components are designed to protect personnel from exposure to electrical shock.

Table 5 identifies potentially hazardous energy sources that are present when operating the EmiScope-II, and isolation methods.

TABLE 4. Hazardous Energy Isolation

Danger	Description	Hazard prevention
Electrical energy	Hazardous voltages	All doors and enclosures sides are locked and require a tool for service access. Lock-out/tagout is available for all hazardous energy sources, including system controller, power distribution unit, and pneumatic supply. Non conductive or grounded conductive physical barriers are provided where failure of liquid fittings from any part of the equipment could result in the conduction of liquid into electrical parts. System interlocks shut off power to entire system except for PC.
Suspended weight	Pinch point	The EmiScope-II table top is supported by an air cylinder. When there is a total loss of system air pressure, the z-stage will not move. All doors and enclosure sides are locked and require a tool for service access.
Stored pressure	High pressure pneumatics	Pressure relief valves are provided by the regulators themselves, and relieve any pressure higher than 7 psi above the set value. Quick disconnect is provided at the main air supply.

TABLE 4. Hazardous Energy Isolation (Continued)

Danger	Description	Hazard prevention
Hazardous moving parts	Pinch point	The EmiScope-II table top is supported by an air cylinder. Hazardous areas are enclosed within the optical table. Interlock switches on the optical table panel de-energize the unit when the panel is removed. All doors and enclosure sides are locked and require a tool for service access.
Infrared Laser Hazard	Skin and eye hazard from direct radiation	The hazardous area is enclosed within interlocked enclosures. Interlock switches on the optical table panel and table top de-energize the unit when the panel or DUT is removed. All doors and enclosures sides are locked and require key for service access.

- **To verify that the EmiScope-II is isolated and properly de-energized,**

1. Check for pneumatic isolation and de-energized state:
   Verify that the pneumatic panel Main switch is in OFF position.
   Use key to lockout Main air valve switch.
   Verify that the pneumatic panel pressure gauge is 0 PSI.
2. Check for electrical isolation and de-energized state:
   Check to see that the Main Disconnect has a lockout/tagout device (LOTO) attached, and in plain sight.
3. Verify that the light on the main power distribution unit (PDU) is not illuminated.

- **To release the EmiScope-II from its isolated state,**

1. Use key to engage the pneumatic panel Main air valve switch.
2. Turn the Main pneumatic switch to the ON position. Verify that pneumatic panel pressure gauge is greater than 0 PSI.
3. Remove the lockout/tagout device from the Main Disconnect power cord. Plug power cord into power outlet.
4. Verify that the main power distribution unit (PDU) is ON and the PDU light is illuminated.

Laser Safety

The EmiScope-II is a Class 1 laser product integrating a Class II embedded laser. The embedded laser is a registered 670nm, 0.9mW CW laser that is fully enclosed in the EmiScope-II optical table enclosure. Safety interlocks are provided on removable optical table enclosures. Access to laser areas is not required for operation or maintenance of the system.

CAUTION: Use of controls or adjustments or performance of procedures other than those specified herein may result in hazardous radiation exposure.

Seismic Safety

The EmiScope-II is designed to be secured against damage caused by seismic events. The method of securing the equipment is to anchor to the floor using brackets and screws. The following components should be secured.

- The system electronics rack.
- The optical table.

Each system ships with a kit to anchor these components. See "Seismic" on page 199.

Moving Parts Hazards

The EmiScope-II is designed to prevent exposure to moving parts during normal operation.

- All moving parts are completely enclosed.
- Guards are in place that if removed de-energizes the system (except PC).
- Probability of injury is minimal and minor severity of hand entanglement.
- Guards are removed only during certain maintenance procedures performed by qualified personnel.

When maintenance and service procedures are performed, the mechanical hazards are removed by powering down the system or component assemblies and performing lockout/tagout procedures (see "Lockout/Tagout" on page 21).

Always use extreme caution when performing maintenance on any part of the EmiScope-II system. Always observe the following precautions when servicing mobile components.

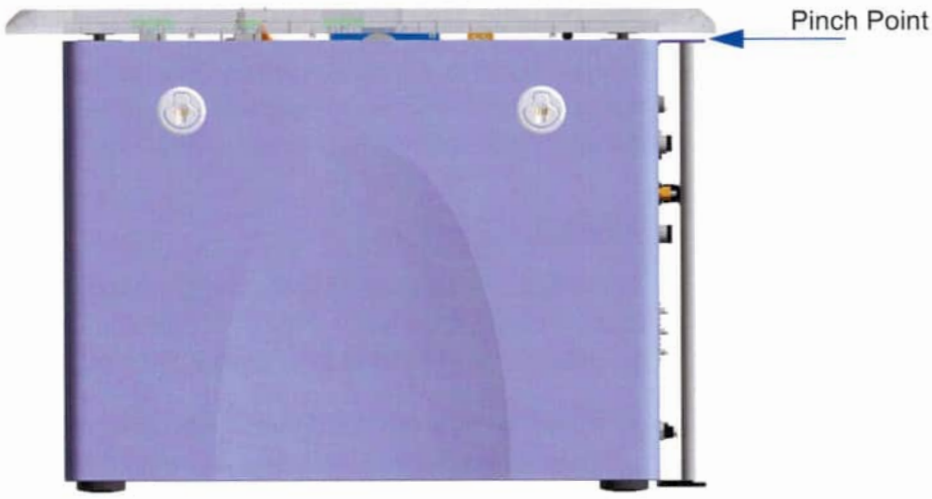
- Always use caution when performing maintenance on any moving mechanical component.
- Never insert fingers, hands, or other body parts into moving parts.
- Never wear loose-fitting clothing.
- Remove all jewelry such as watches, rings, and bracelets.
- Always turn off, lock out, and tag out power in the system before working on the components.
- Use care when working with the system to avoid being pinched, scraped, or bumped. It is possible to receive minor physical injuries when operating or servicing the equipment.

Component(s) Guard

Pinch points are possible during certain maintenance situations. Potential pinch points exist when docking the EmiScope-II to an Automated Test System. Warning labels are placed on the ATE and EmiScope-II systems to identify potential pinch points. When docking/undocking ATE, never place hands between the EmiScope-II table top and table frame, and never place hands into the EmiScope-II table top opening. Failure to observe this warning could result in injury to personnel or equipment damage. The XYZ stage in the EmiScope-II system should be at the home position during ATE docking/undocking. Failure to place stages in the home position could result in personal injury or equipment damage.

Do not operate the stages without the optical table panel guards in place. Avoid placing fingers inside the EmiScope-II tabletop opening when it is being operated. Failure to observe this precaution could result in injury to hands/fingers by the stages while this component moves or closes.

FIGURE 12. Potential Pinch Point



Clearing a Crash

The lens protection system consists of omnidirectional mechanical switches on the high magnification objective connected to a relay circuit. If the switches are activated when the objective comes in contact with something, an alarm will sound at the control pad and the stages will be locked out until the switch is cleared.

- **To clear a crash,**

1. In the EmiScope-II software application Navigation Mode, click the Stop button on the tool bar to halt stage control.
2. In Navigation mode, switch on the inspection camera.
3. In the Navigation control panel, change the Z stage coordinates to 0 units.
4. From the control pad, push and hold the Override button (see Figure 7, "STOP Button on EmiScope-II Control Pad," on page 19.
5. Click the Go button in the navigation control panel to move the stages down or use the Move command from the Navigation menu.
6. Visually confirm the stage is moving the correct way and, if not, press the Stop button.
7. Inspect the system and initialize the stages.

8. Inspect objectives, turrets and components as necessary.

Pneumatic Hazards

The EmiScope-II contains pneumatic assemblies which are driven by CDA supplied at 75-85 psi, to operate air cylinders. The CDA supply must be regulated at the source to prevent overpressure in the pneumatic assemblies.

Pressure Failure

The pressure requirement for the EmiScope-II is approximately 80 psi. The relief valves are provided by the regulators themselves.These valves will relieve any pressure higher than 7 psi above the set value.

- **When there is a loss of system pressure,**

1. Turn off the main pneumatic air valve switch.
2. Turn off the air valve switches to the system components.
3. Use key to lockout the main pneumatic air valve switch.

The z-stage will not function properly when there is a total loss of system air pressure. We recommend you shutdown the entire system following normal system shutdown routines until the system pressure loss situation is resolved (refer to "Shutting Down EmiScope-II" on page 58). After normal system air pressure is sustained, follow system start-up procedures (refer to "Starting Up EmiScope-II" on page 43).

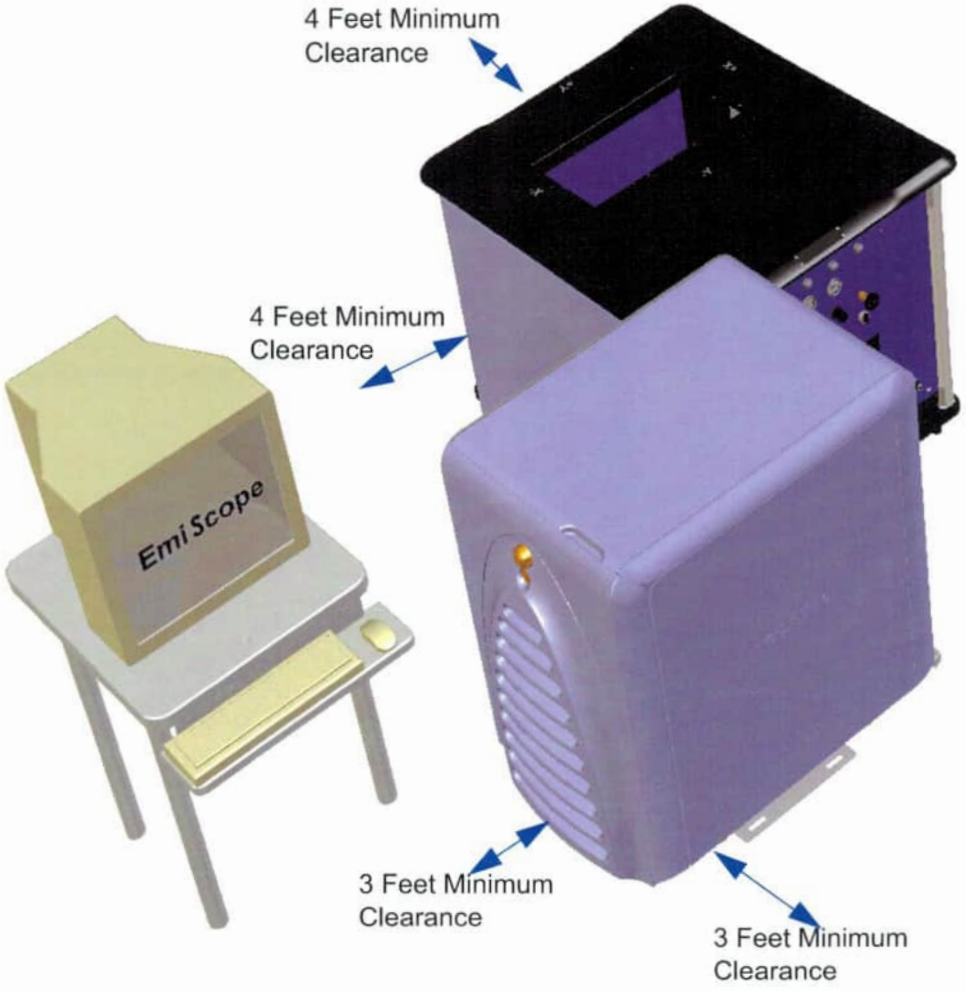
Maintenance and Service Safety

The EmiScope-II is designed to optimize maintenance and service safety. Maintenance and service safety features are briefly described here as well as safety practice and procedure information. Additional safety information can be found in "Installation and Maintenance" on page 173.

1. Use two hands to lift, remove or replace the optical bench and the water chiller. Using proper lifting techniques will help to prevent injury to personnel and equipment damage.
2. Clearances for finger access is 1.5 inch (38mm). The clearance space between the table top and frame is labeled as a pinch point when table air pressure is de-energized.

3. All handles are radiused and enclosed.
4. Use a portable light that doesn't need to be held when servicing the optical table.
5. Clearances around the back and side perimeter of the EmiScope-II are minimum 48". A minimum clearance of 36" is required in the front of the system electronics rack.
6. Service clearance is provided for two hands, arms, to shoulder. Access is 30" width from side of optical table.
7. All service access, doors and enclosures sides are locked and require key access. The connecting bracket between the electronics rack and optical table swings for access to one side by lifting one hinge pin.

FIGURE 13. EmiScope-II Minimum Maintenance Access Clearances



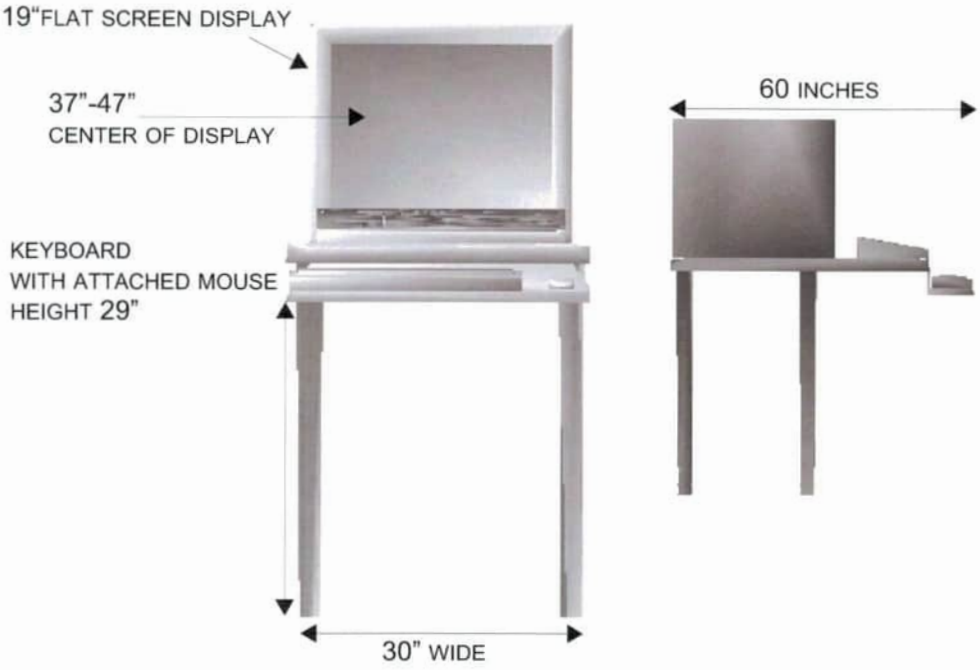
9 Feet x 13 Feet Minimum Floor Space for EmiScope-II

FIGURE 14. EmiScope-II*t* Minimum Maintenance Access Clearances

9 Feet x 13 Feet Minimum Floor Space for EmiScope-II*t*

8. Serviceable components are replaceable as modular packages (see "Maintenance and Service" on page 210). They are independently accessible with individual support rails.
9. All cables are labeled on each end for cross connection.
10. The location of operating primary interface is the workstation keyboard (29"). The workstation includes a 19" flat screen display, keyboard and mouse attached to the keyboard. The height of the center of the display is between 37 to 47 inches.

FIGURE 15. Workstation Ergonomics



11. There are no service procedures required on the EmiScope-II that are performed when system is energized. There are no Type 3, Type 4, or Type 5 electrical tasks.
12. The following liquids are used in the EmiScope-II operation: Steam distilled water. The EmiScope-II uses a water chiller to control the temperature of the photon detector. To prevent leakage, the detector incorporates double containment on hoses leading to the drip pan.
13. The EmiScope-II is sufficiently large and complicated to require at least 2 people to perform some maintenance tasks. The EmiScope-II component weights are provided in the section "Seismic" on page 199, of "Installation and Maintenance" on page 173.

TABLE 5. Plastics Flammability Data

Plastic Location	Plastic Type	Flammability Rating
Pneumatic Panel fittings	Polyurethane	V-0
Pneumatic Panel Tubing	Polyurethane	V-0
Table Top	EPDM	V-0
Drip Pan in electronics rack	FR Polypropylene	V-2
Water Chiller hoses and double containment	Tygon	V-0
Electronics Rack top, sides, and door	Royalite R59 Thermoplastic	UL94-5VA
Optical Table Sides	Royalite R59 Thermoplastic	UL94-5VA
E-chain between electronics rack and optical table	Igumid NB	VDE 0304 IIC UL 94 V-2
E-chain Between electronics rack and monitor/keyboard	PA6	V-2
Cables Between Electronics Rack and Optical Table (all C cables)		
< 150 lbs	PVC	V-2
Cables within System Controller (all CC Cables)		
< 10 lbs	PVC	V-2
Wire Ways		
< 5 lbs	PVC	V-2

CHAPTER 3

Starting Up the EmiScope-II

This chapter begins with a description of how optical diagnostics are used to measure switching (timing) events in semiconductor devices, optoelectronic waveform acquisition and high-bandwidth timing analysis. It then describes how to prepare a device for testing, how to start up the EmiScope-II system and software, and how to shut down the system. A troubleshooting section at the end of the chapter provides a list of typical problems that may occur and their solutions.

CAUTION: To avoid injury to personnel and equipment, read the Safety section prior to performing any of these procedures. These procedure should only be performed by qualified personnel. See the document Preface sections "Hazard Levels" and "Visual Hazard Alert Symbols", and "Safety" on page 7 for important safety information.

Process Overview

The EmiScope-II obtains timing information from internal node device emission through the silicon backside of integrated circuits. Therefore, in order to successfully obtain timing information it is necessary to stimulate the DUT as well as navigate the microscope to the desired probe point.

DUT stimulation is typically done with ATE. The test programs and patterns can be of any type (e.g. functional, scan-based, etc.). Because photon measurements are statistical in nature and the probability of emission is small, it is necessary to sample in time. This necessitates repeatedly executing a set of test vectors by creating a test loop. The EmiScope-II measures photon arrival times relative to an externally supplied reference trigger signal generated by the ATE. The reference trigger pulse occurs one time each test loop. Since the trigger pulse has a fixed relationship to the test vectors, the timing of an event can be determined relative to this trigger. Since the EmiScope-II makes all measurements relative to this signal, its timing position is defined as zero. In order to make measurements at arbitrary points within the test loop, a non-zero, positive delay setting can be used. It should be noted that device stimulation can also be applied by using external power supplies and a programmable stimulus source or data generator rather than with ATE.

In addition to device stimulation, it is necessary to accurately navigate to the position of interest. Since the photon emission emanates from the gate regions of transistors, it is necessary to have transistor-level visibility. The EmiScope-II achieves this by using a broadband source of illumination in conjunction with the microscope optics and an InGaAs Near Infra-red (NIR) imaging camera. This allows the user to image the active layer (device layer) of the DUT in real-time. The imaging capability is combined with an alignment algorithm in order to establish a Position or CAD Alignment. This is the mathematical correspondence of the live image with the device CAD data or database coordinates. Therefore, if the database coordinate of a particular transistor is known, the microscope can automatically move to this position on the DUT.

In order to make a timing measurement one must first mechanically dock the DUT and ATE to the EmiScope-II. Various tester interfaces are available as well as custom solutions. Next the test program (test loop) would be loaded and run verifying a suitable trigger signal is being generated. Typical test loop lengths range from 30 to 100 μs (10-33 kHz repetition rate). At this point a CAD or Position Alignment would be performed resulting in the ability to drive the stages (microscope) from the CAD Layout or by entering predetermined database coordinates. Once the transistor of interest has been identified and the microscope objective has been moved into position and properly focused, the acquisition parameters can be set or adjusted. The settings are similar to those of a standard oscilloscope. The timing window in which data will be collected is set by adjusting a delay and timebase

(time/div) settings. Additionally, as with an oscilloscope, a y-scale sensitivity can be adjusted changing the appearance of the emission histogram displayed.

The length of the acquisition is dependent upon many factors including the supply voltage and transistor size. Therefore, acquisition times may vary significantly. Moreover, acquisition times are also affected by the purpose of the acquisition. For example, identifying a logic state would take significantly less time than making a highly accurate (< 10 ps) edge measurement.

Figure 18 shows a typical timing diagram of a typical acquisition process. The top panel shows one complete cycle of the ATE instruction loop, which in this example lasts 100 µs. The beginning of each ATE instruction loop is identified by a high-speed trigger signal delivered by the ATE test head to the EmiScope-II timing electronics using a 50Ω coaxial cable.

FIGURE 16. EmiScope-II Pneumatic Panel, Trigger Input Location

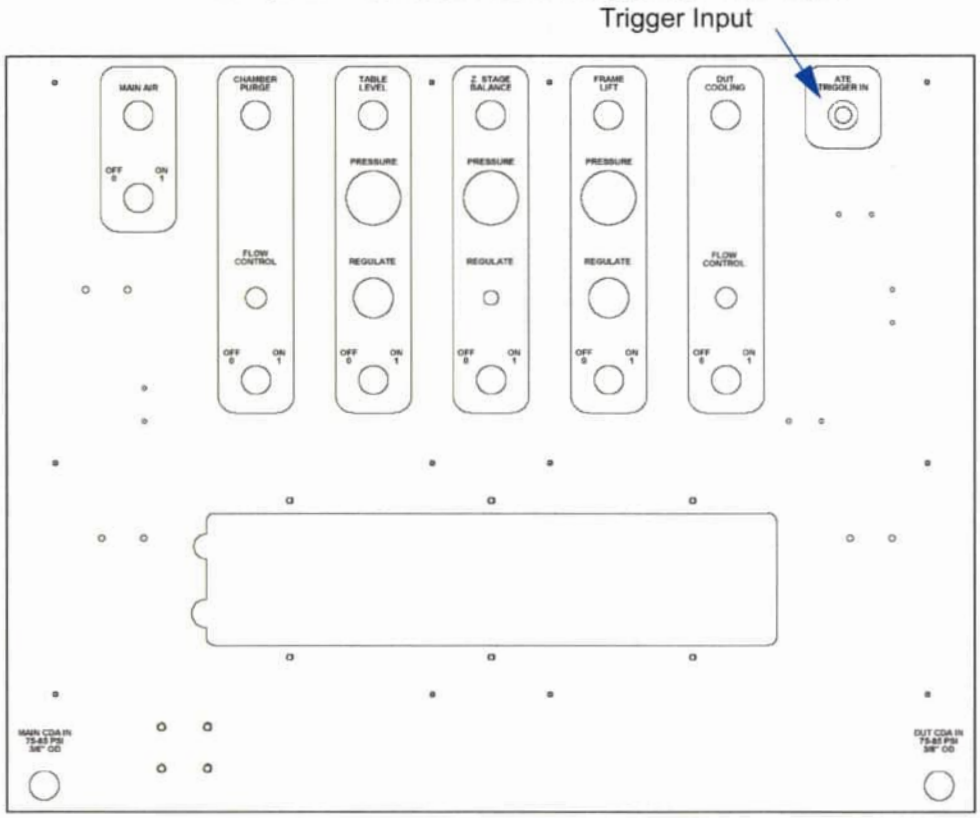
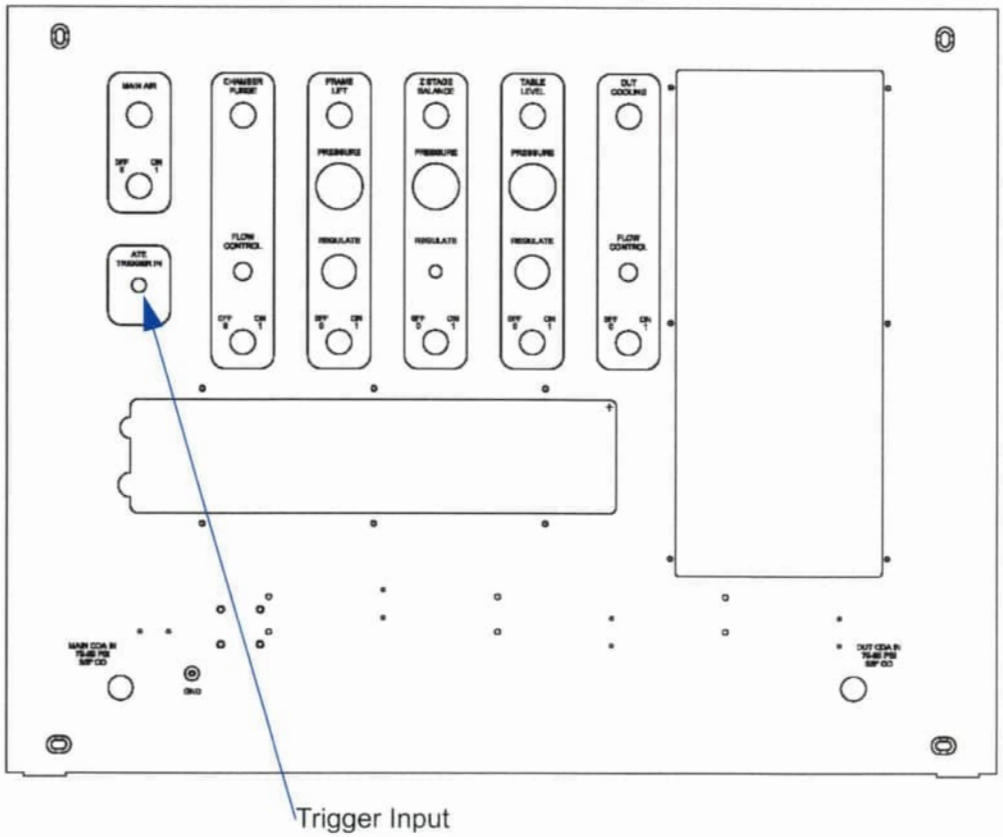
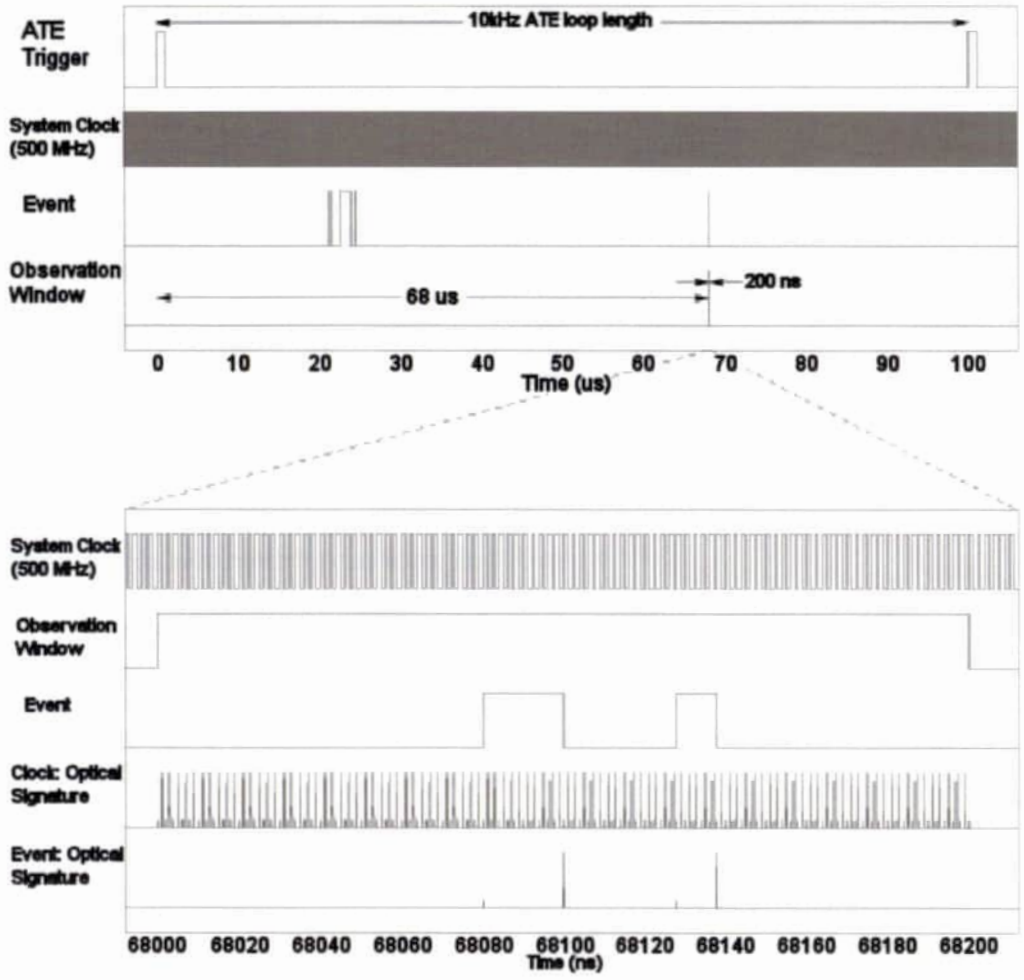


FIGURE 17. **EmiScope-II*t* Pneumatic Panel, Trigger Input Location**



In this example, a DUT is running at a master clock rate of 500 MHz, and a failure event is detected by the ATE approximately 68.1 µs into the ATE instruction loop. Note that at the horizontal time scale shown in the top panel of Figure 18, the 500 MHz system clock cannot be resolved. The beginning of the ATE instruction loop must be indicated by a high-speed signal, delivered on a 50Ω coaxial cable, from the ATE to the EmiScope-II timing electronics. The EmiScope-II microscope is then directed to observe the failing node. Once located on the DUT, dynamic emission from this node can be observed. A timing window is then drawn around the expected event, in this example by making the photon-collection system active between 68.0 µs and 68.2 µs, as shown in the lower trace – labeled "Observation Window" – of the top panel. Note that events may occur outside of this period of time, but only those events within the observation window will be recorded by the data acquisition system.

FIGURE 18. Timing Diagram of a Typical Data Acquisition Cycle



The bottom panel of Figure 18 expands on the region of time surrounding the desired event to record. At this horizontal time scale, the 500 MHz clock is easily resolved. For clarity, the observation window is shown again in this panel, and clearly indicates how data is only collected by the EmiScope-II tool while this window is active. The bottom two panels show the optical signal collected off both the master system clock and the event under study.

The bottom panel shows a tiny portion of the region shown in the top panel, as it would be recorded by the EmiScope-II tool. In this example, an event is

identified for study that occurs about 68.1 µs into the ATE instruction loop. The system is made active during the observation window, which is itself programmable relative to the ATE trigger signal. The resulting data collected, both from the selected event and from the master clock, can be used to characterize the observed failure.

Note that dynamic emission is detected from both edges of the observed signals, but the positive-to-negative transition results in much greater detected signal. This effect is due to the difference in hot carriers that are responsible for the dynamic emission. The observed dynamic emission signal from positive-to-negative transitions results from hot electrons within n-channel FETs of the CMOS pair, while the emission during negative-to-positive transitions is due to hot holes within the p-channel FETs of the CMOS pair. It happens that the hot electrons become "hotter" than the hot holes in silicon, hence the dynamic emission from falling edges is substantially brighter than emission from rising edges.

Since the optical emission from a switching device coincides with the current rush through the respective transistors, the recorded optical signature provides a direct non-invasive measurement of device switching times. A direct comparison between the optical emission from the failure event and from the master clock, or between the failure event and the ATE trigger signal, can identify device switching times to substantially better than the 50 picosecond level accuracy.

Device Preparation

The EmiScope-II is a diagnostic timing tool designed to capture dynamic device emission through the backside of silicon integrated circuits. As such, it is necessary to prepare the silicon substrate to maximize transmission of the photon emission from the chip device layer, through the silicon substrate, into the EmiScope-II's infrared (IR) microscope. The sample preparation also optimizes the transmission of the EmiScope-II's illumination system into and out of the silicon substrate, enabling imaging and navigation capabilities of the device under test (DUT).

Sample preparation for the EmiScope-II consists of two basic steps: substrate thinning and surface polishing. The substrate thinning consists of bulk silicon removal to a final substrate thickness (distance from silicon-air inter-

face to chip device layer) of 100μm ± 50μm. The surface polishing should leave the backside silicon surface with an "optical quality" finish as specified by the appropriate polishing procedure and materials. More information on sample preparation can be found in the external document: EmiScope-II Sample Preparation.

The device-under-test must be properly prepared before usage in EmiScope-II.

- **To prepare the DUT,**

1. Thin the device backside bulk silicon to ~100μm remaining silicon. The acceptable range for the remaining bulk silicon thickness is 50μm - 150μm.
2. Polish the thinned device to optical quality.
3. If optional air-coupled lenses are used on the EmiScope-II, anti-reflective coating (ARC) should be applied to the device after polishing.

NOTE: ARC should not be used in conjunction with the Solid Immersion Lens.

4. Take emission measurements from the DUT by looping the appropriate test parameters to stimulate the nodes of interest, and creating the electrical DUT environment necessary for node measurement criterion.

NOTE: Proper DUT preparation is essential for effective use of the EmiScope-II. The final silicon surface after polishing should be well polished and flat across the entire surface of the die to within 10μm. The use of improperly prepared devices may result in image and photon collection degradation.

Starting Up EmiScope-II

Prior to system start up, make sure that the system was properly shut down, and that the components are in the proper places (refer to "Component Shutdown" on page 59). Prior to docking to an ATE system, visually confirm from the table top opening that the stages are in the home position.

- **To start up the EmiScope-II system,**

Safety: Pneumatic Type.

1. Open the Main pneumatic switch. Refer to Figure 16 and Figure 17.
2. Open the Table Level switch and adjust pressure to 30-45 psi.

3. Verify that the table is floating on all four pistons within 1/8-1/2 inch. Manually adjust using the table height levers if necessary.
4. Open the Z Stage Balance valve and set the pressure to 43 psi for z-stage balance.
5. If desired, open the Frame Lift valve to life the table frame from the floor. The Frame Lift, when off, lowers the table frame so that the table frame casters contact the floor. In this state, the EmiScope-II table frame can be moved.
6. If necessary, open the Chamber Purge valve to purge the EmiScope-II optical table interior with clean, dry air.
7. If necessary, open the DUT Cooling valve to direct clean, dry cooling air to the DUT. The maximum DUT heat dissipation using the DUT Cooling is 6W/cm^2 to maintain a die temperature of 100 degrees Celsius.
8. Record internal and external starting temperatures.

FIGURE 19. EmiScope-II Pneumatic Panel, Main Pneumatic Switch Location

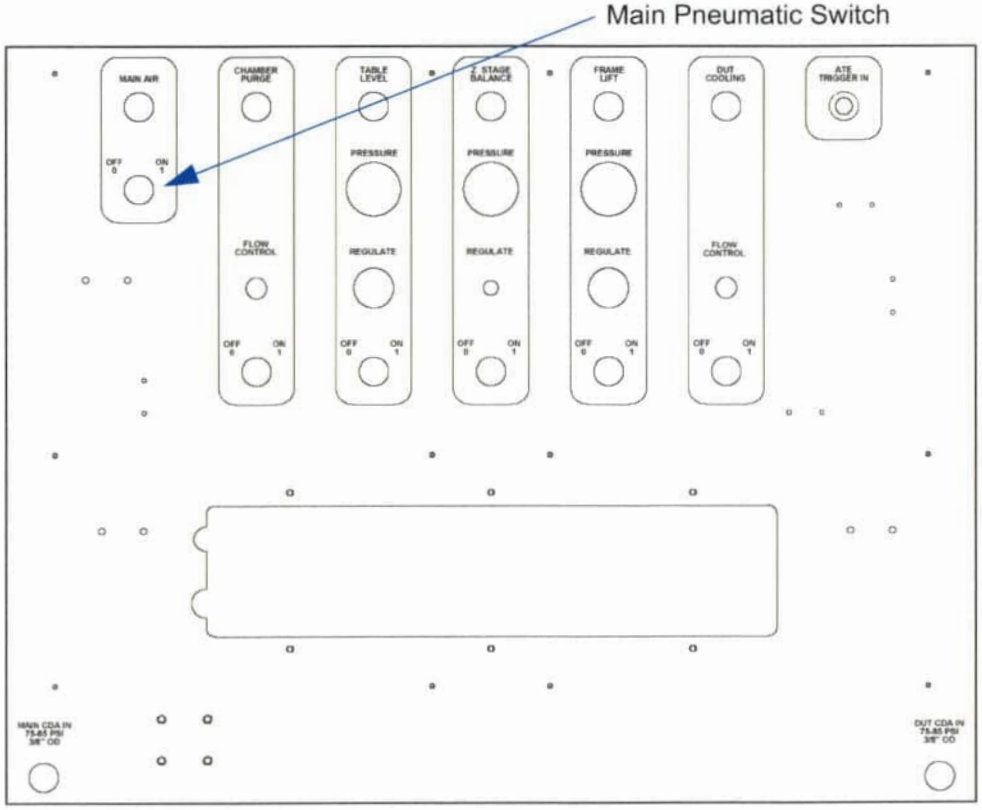
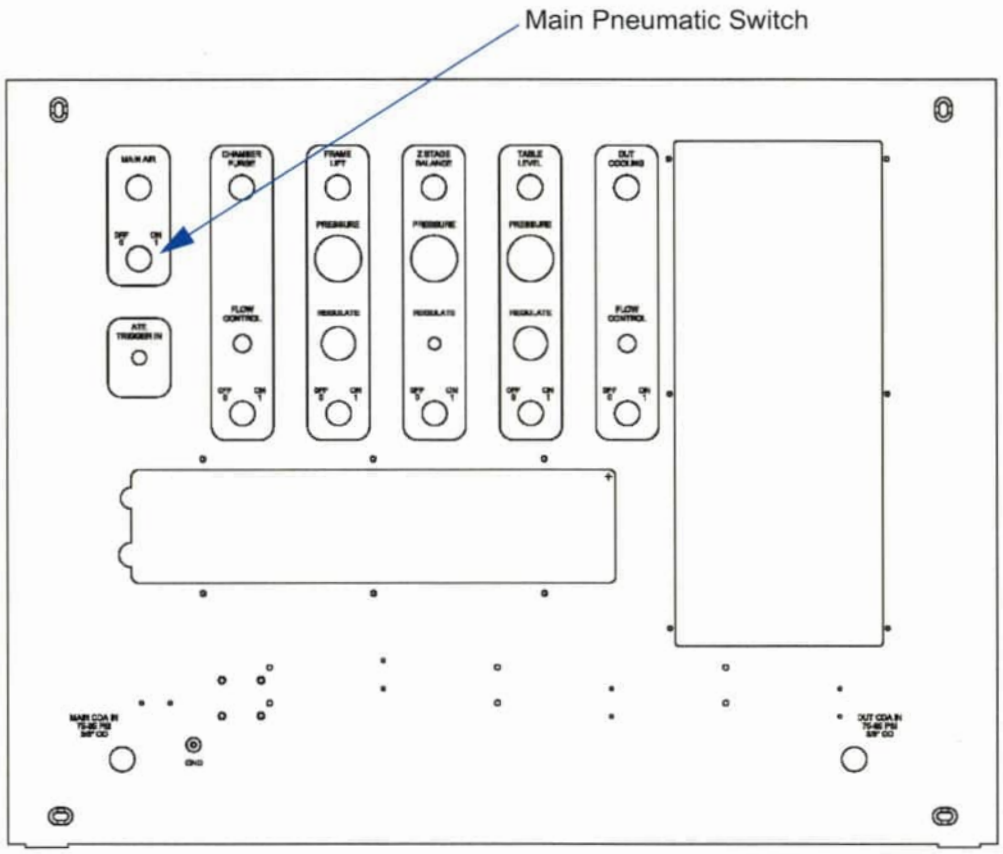


FIGURE 20. EmiScope-II*t* Pneumatic Panel, Main Pneumatic Switch Location



Safety: System electrical state Type 2 task.

9. Turn on the EmiScope-II controller main power.
10. Turn on the stage controller if it is powered down.
11. Turn on the Nim bin if it is powered down.
12. Turn on the water chiller if it is powered down.

Note: The EmiScope-II system is normally powered at all times. System power up procedure need only be followed if the system has experienced a power loss.

13. Install a properly prepared DUT on a standalone interface board, or installed on an ATE docking interface. Ensure DUT integrity through standalone or ATE testing, and verify DUT test loop parameters prior to use on the EmiScope-II.

14. Start the EmiScope-II software application. If necessary, power up the EmiScope-II PC. Log-on to the PC using user name and password assigned by your system administrator.

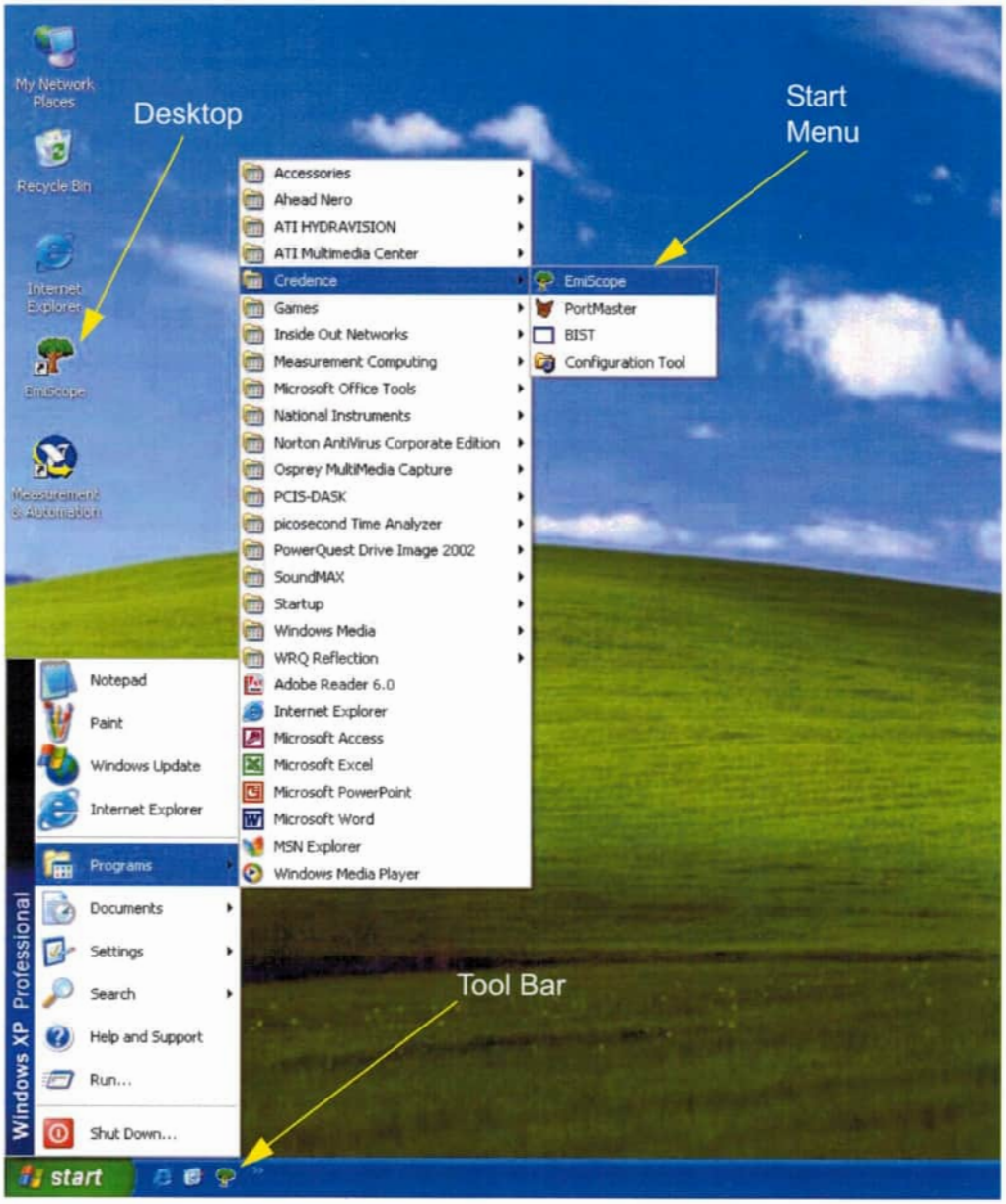
Starting Image Acquisition and Alignment

This procedure describes EmiScope-II software startup procedure, how to set up lens protection files, and use the software to acquire a DUT image. For more information on how to use DUT imaging, see "Navigation Mode" on page 73.

Launching the EmiScope-II Software

The EmiScope-II software application can be started by clicking on its icon in the tool bar, clicking its icon on the desktop, or using the start menu. The EmiScope-II software application has the look and feel of most Windows applications with a menu bar, a tool bar, a status bar, and standard controls for moving, resizing, etc. You can close the window and end the application using the File menu command Exit, clicking on the X in the upper right hand corner, or double clicking in the upper left corner of the window. This section describes the basic layout and controls for the Navigation Mode of EmiScope-II software application, and provides a short demonstration of its use and details for each feature.

FIGURE 21. Launching the EmiScope-II Software



1. The two operational modes of the EmiScope-II software application, Navigation mode and Acquisition mode, are similarly designed for ease of use.

FIGURE 22. Navigation Mode

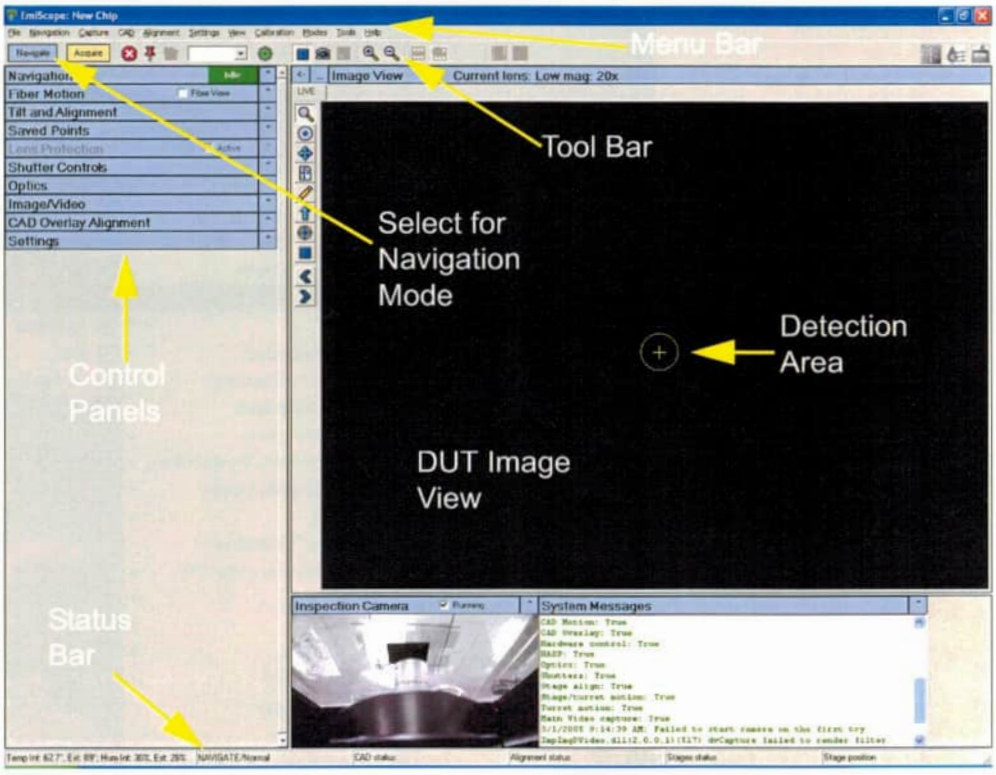
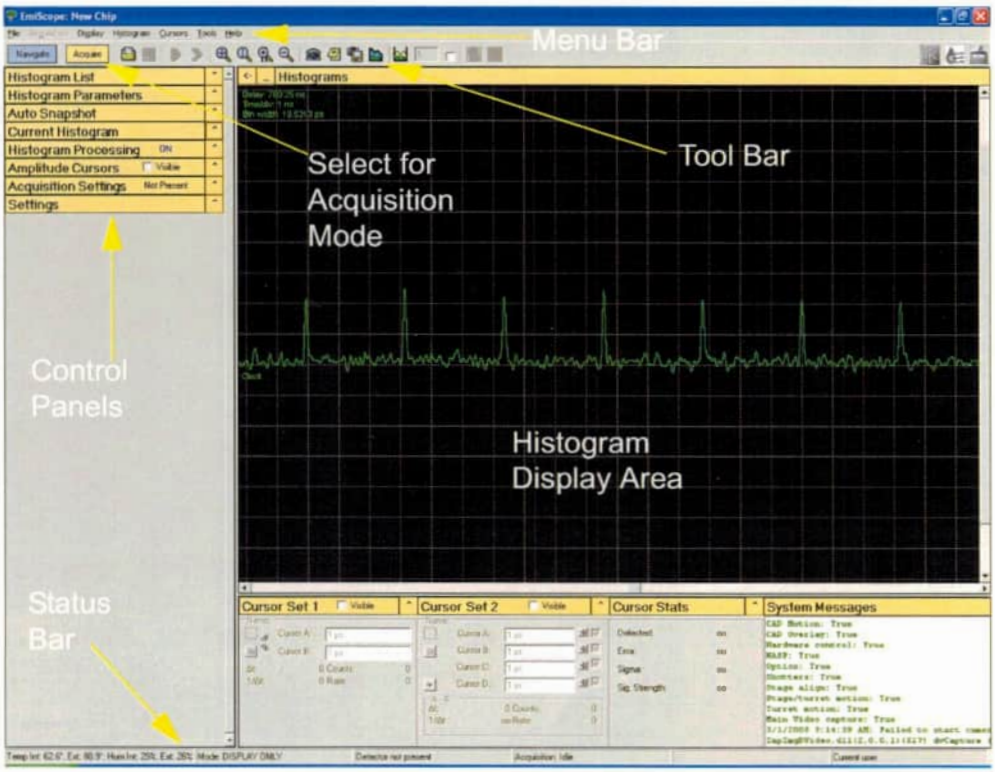


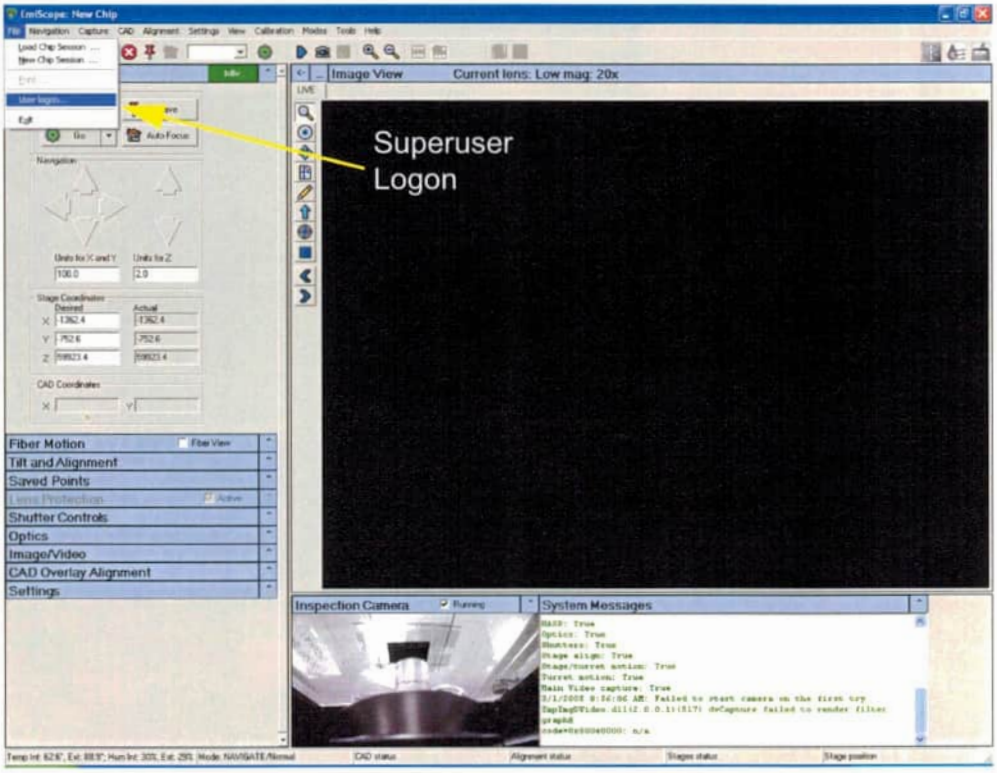
FIGURE 23. Acquisition Mode



Superuser Functions

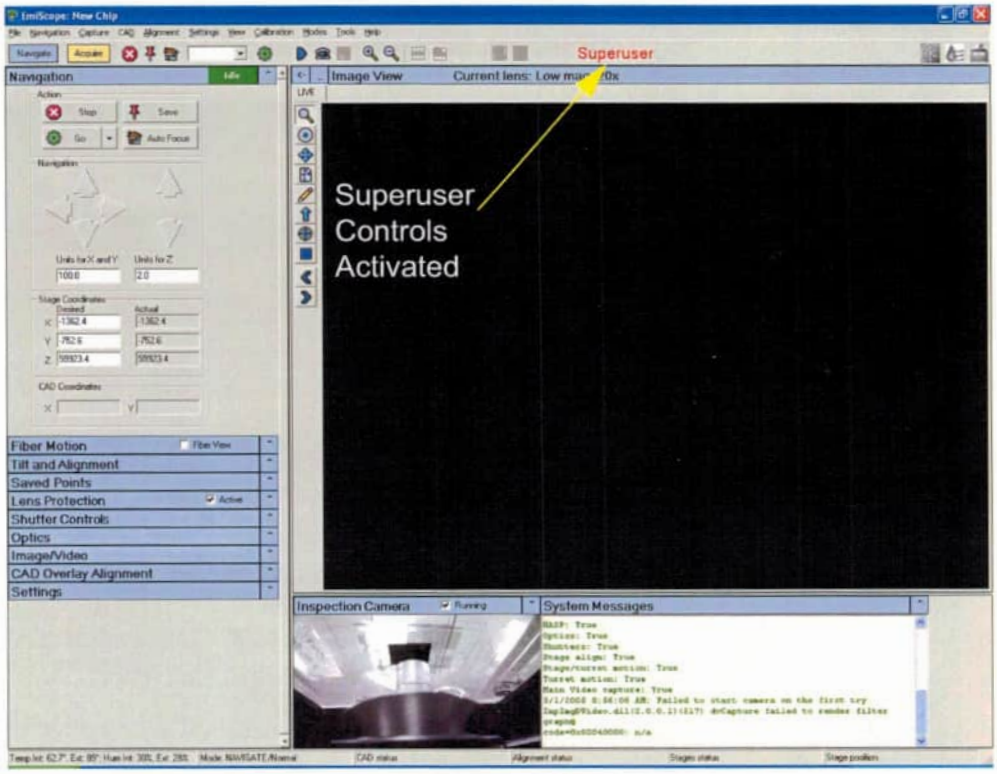
- Note: Certain functions of the EmiScope-II software are password protected (Superuser controls). Access to these functions are not allowed without entering the correct Superuser password. Superuser functions are noted when used in this manual.
- To access Superuser functions, select User logon from the File menu. See Figure 24. When the correct username and password are entered, the Superuser functions in both Navigation and Acquisition modes are enabled. See your EmiScope-II system administrator for Superuser access, or contact Credence technical support.

FIGURE 24. Accessing Superuser Functions



- After a successful Superuser logon, an indicator will appear in the EmiScope-II software application signifying Superuser controls are activated. This indicator will remain active until Superuser logout. See Figure 25 on page 51.

FIGURE 25. Superuser Controls Indicator



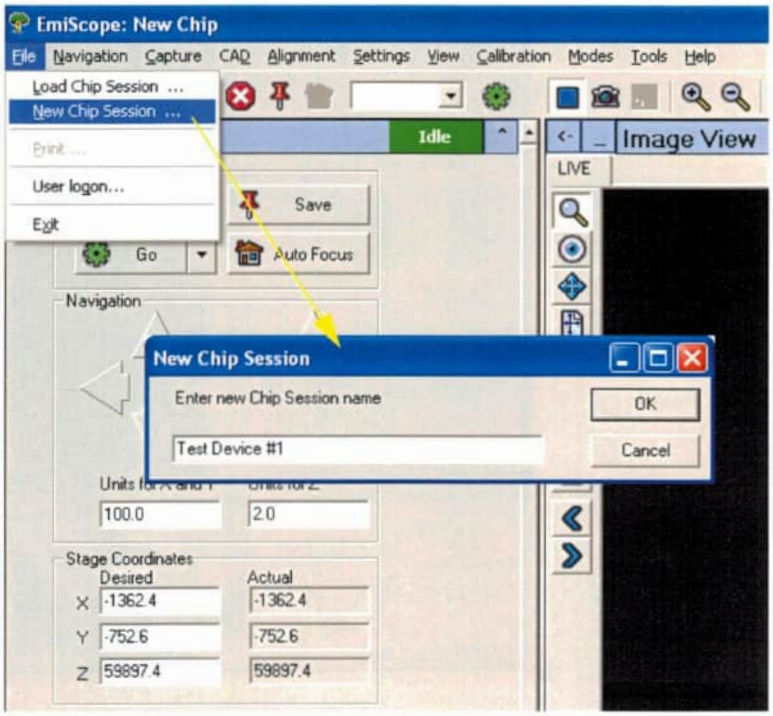
Credence Support Functions

- Note: Certain functions of the EmiScope-II software are protected by a second level of password. Access to these functions require entering the correct Superuser password, and then entering the correct Credence Support password. Credence Support functions are noted when used in this manual. See “Configuration Tool” on page 216 for more information on Credence Support functions.

2. Upon start-up of the EmiScope-II software application, you should select either a New Chip Session... , if you are using a device for the first time on the EmiScope-II, or Load Chip Session..., if you have previously used a device, from the Navigation mode File menu. The use of Chip Session allows you to retain device coordinate and alignment information which

enables rapid device re-alignment, see "Tilt and Alignment Control Panel" on page 97.

FIGURE 26. Navigation Mode Chip Session Menu



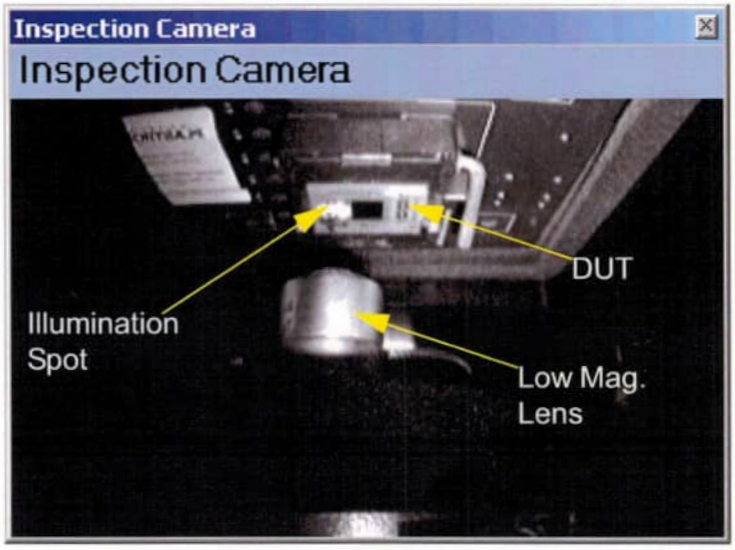
3. To begin DUT imaging, select Navigation mode and select the Inspection Camera Running check box to open the Inspection Camera and obtain a view of DUT and stage/objective position.
4. Select the Low magnification objective in the Optics/Video control panel.
5. Select the Illuminator check box from the Optics/Video control panel. Prior to stage movement, make sure that illumination is at maximum by moving the Illuminator slider to the maximum value.

Note: Initial DUT imaging on the EmiScope-II system must be first performed using the low magnification lens.

6. From Navigation panel, use the arrow keys to drive the XY stages to the approximate center of the DUT using the Inspection Camera view as a reference.

7. Focus on the DUT with the Navigation up/down arrows (Z-stage). The light spot from the illuminator can be used as a reference when moving the Z-stage. As the objective approaches the DUT (moving the Z-stage up), the illumination spot on the DUT will become more focused (smaller, tighter light spot).

FIGURE 27. Inspection Camera and Illumination Spot



Setting Up the Lens Protection File

A lens protection area should always be defined when using the EmiScope-II to avoid the possibility of equipment and/or DUT damage. The stage cannot be moved outside the stage positions defined in the lens protection data file.

Note: Defining, loading, enabling, and disabling Lens Protection files are Superuser functions. See "Superuser Functions" on page 49.

Note: Defining the lens protection area must be performed using the low magnification lens.

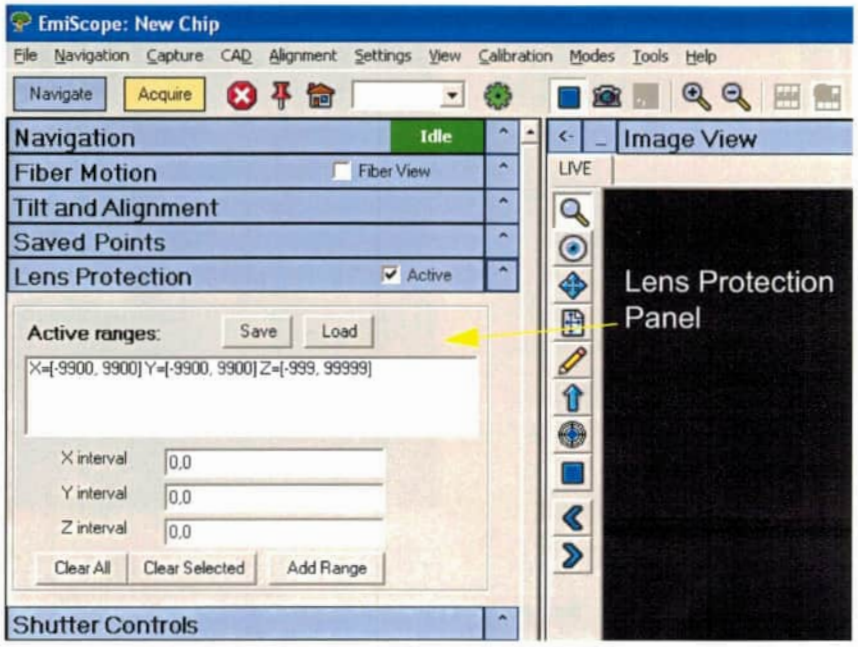
- **To set up the lens protection area,**

1. After focusing with the Low magnification lens, use the Navigation panel to move the XY stage so that the image view is of the top-right corner of the DUT.

For more information on how to use the Navigation control panel, refer to "Navigation Control Panel" on page 78

2. Note the XYZ position of the stage in the Navigation panel. Repeat steps 2 and 3 for the lower-right and lower-left corners of the DUT.
3. Use the Lens Protection panel to define the protection area.

FIGURE 28. Opening the Lens Protection Panel from Navigation mode



Enter the stage positions of the DUT corners noted above in the following format:

Xinterval = minimum, maximum stage X position allowed

Yinterval = minimum, maximum stage Y position allowed

Zinterval = minimum, maximum stage Z position allowed

Add Range = adds X/Y/Z intervals to Active ranges

Clear All = clears all Active ranges

Clear Selected = clears selected Active range

Multiple Active ranges can be defined to form a "stacked box" lens protection area. When using multiple Active ranges, the EmiScope-II software will compare the location of the XYZ stages to each Active range interval, and if the XYZ stage location is in violation of any Active range interval, the Lens Protection will prevent any XYZ stage movement.

Any Active range(s) can be saved to a Lens Protection file using the Save command. Previously saved Lens Protection files can be loaded for use by the Load command.

4. Enable Lens Protection in the Lens Protection panel by clicking on the Active check box. Once the Lens Protection Area is enabled, the stage cannot be moved outside the stage positions defined in the crash protection data file.
5. To disable the Lens Protection area, uncheck the Active check box.

Note: If Lens Protection is disabled, there is the possibility of system and/or DUT damage. The EmiScope-II system should never be used without Lens Protection.

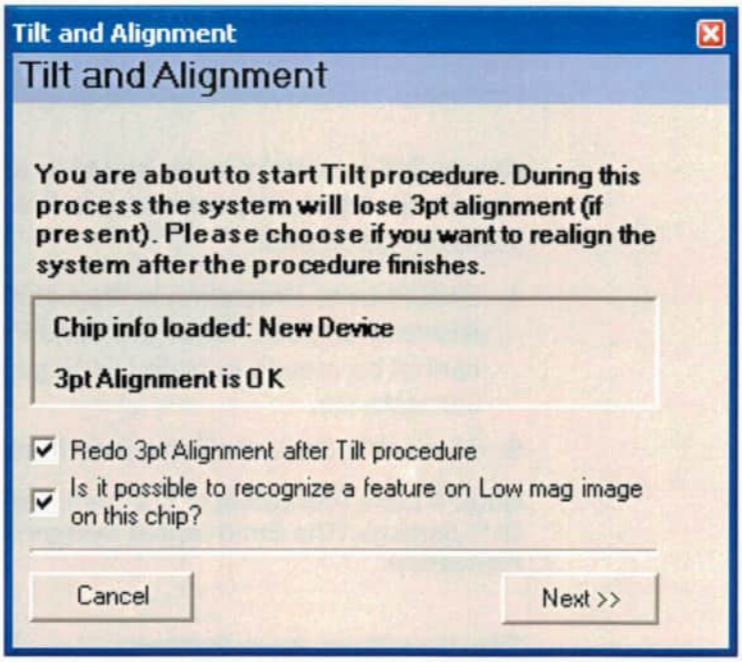
Starting Data Acquisition

Once the lens protection file is created and enabled, you can begin data acquisition.

- **To start data acquisition,**

1. Using the low magnification lens, move to desired probe location using either CAD coordinates (see "Three Point CAD Alignment" on page 83) or stage coordinates.
2. Use the Tilt Wizard to ensure proper alignment of the DUT. For more information on the Tilt Wizard, see "Tilt and Alignment Control Panel" on page 97.

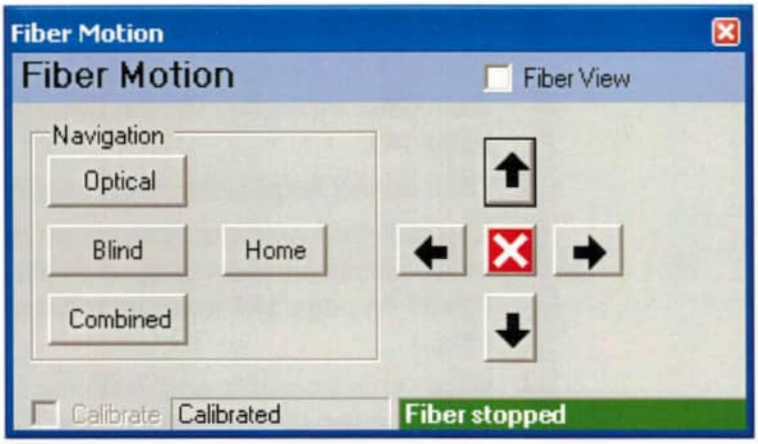
FIGURE 29. EmiScope-II Tilt Wizard


Tilt and Alignment
Tilt and Alignment
You are about to start Tilt procedure. During this process the system will lose 3pt alignment (if present). Please choose if you want to realign the system after the procedure finishes.
Chip info loaded: New Device
3pt Alignment is OK
Redo 3pt Alignment after Tilt procedure
Is it possible to recognize a feature on Low mag image on this chip?
Cancel
Next >>

CAUTION: Before using High magnification, using the Tilt Wizard is required to prevent possible damage to the DUT and/or EmiScope-II system and to ensure optimal DUT imaging.

3. Switch to the High magnification lens. See "Magnification and SIL Landing" on page 88.
4. Use Navigation mode to enable the detection circle(fiber cross-hair).
5. Using the mouse, drag/move the detection circle to the node of interest.
6. Use the Fiber Motion control panel to center the photon collection fiber on the node of interest. For more information on Fiber Motion, see "Fiber Motion Control Panel" on page 106.

FIGURE 30. EmiScope-II Fiber Motion Control Panel



7. If necessary, from the Shutter Controls panel, use the blade controls to block-out any DUT transistors in the detection circle that are not of interest.
8. Select Acquisition mode.
9. In the Acquisition Settings panel, enter the appropriate Gate Offset and Gate Width settings for acquiring node of interest.

Acquisition Mode

For more information on how to use Acquisition mode refer to "Acquisition Mode" on page 121.

1. Set the PTA offset and time span to encompass expected signal acquisition. Refer to"Setting Up the Detector and Electronics Timing" on page 142.
2. Click on the Acquisition menu and select the Start command.
3. The real-time emission acquisition results are provided in the Acquisition mode histogram display area. Refer to "Histogram Processing Control Panel" on page 131 for more information on histogram manipulation controls.
4. When emission data acquisition is complete, switch to Navigation mode to enable the DUT imaging, open the aperture blades, and to move to the next area of interest.

Shutting Down EmiScope-II

When the system is properly shut down the system components are placed in safe locations.

- **To undock the ATE,**

1. If data acquisition is in progress, select Stop Acquisition in Acquisition mode.
2. Switch to the Navigation mode.
3. Use the Navigation panel controls to manually move the XYZ stages away from the DUT, or select Undock from the Navigation menu.
4. Undock the DUT/ATE.

- **To completely shutdown the EmiScope-II system,**

5. If data acquisition is in progress, select Stop Acquisition in Acquisition mode.
6. Switch to Navigation mode.
7. Use the Navigation panel controls to manually move the XYZ stages away from the DUT, or select Undock from the Navigation menu.
8. Terminate the EmiScope-II software application.

9. Log-out of the PC Windows environment.
10. Shutdown the EmiScope-II system using the system controller.
11. If necessary, shutdown the EmiScope-II PC and system pneumatics, and unplug main system AC power supply.

Component Shutdown

When the system is properly shut down the components are placed in the following positions:

1. EmiScope-II controller power is off.
2. The pneumatic system is off and all valves are in their off position.
3. The stages are in the home position.

Troubleshooting

If you have questions about your equipment, please review this section first. If you cannot find the answer, contact Credence.

TABLE 6. Troubleshooting Procedures

Optical	
No image on either objective.	See "Optical Problems" in this section.
Degraded image.	"Optical Alignment" on page 60.
Fiber alignment.	"Fiber Detection Area Alignment" on page 60.

Optical Problems

- **If no image can be obtained using either lens,**

1. Verify the EMO on the system controller is not engaged, and the system power LEDs are illuminated.
2. Verify the stage Stop button on the control pad is not engaged.
3. In the EmiScope-II software application, verify that you are in Navigation mode.

4. Using the Shutter Controls panel, verify the aperture blades are fully open by selecting the Maximize button.
5. Check that the illuminator is fully on by looking for illumination out of the low magnification objective. If it is not on, check to see that the Illuminator check box in the Optics/Video panel is enabled, and that the Illuminator slider is at maximum. If the illuminator is still not operating contact Credence technical support.
6. Verify with the inspection camera that the microscope head is in the proper position and the system is illuminating the DUT. If they are not, contact Credence technical support.
7. Contact Credence technical support once you have completed this procedure.

Optical Alignment

When the DUT image is severely degraded, the problem could be improper DUT tilt, poor device preparation, or the alignment of the EmiScope-II optical system. See "Tilt and Alignment Control Panel" on page 97 and "To prepare the DUT," on page 43.

Optical misalignment can occur with a crash or overextended use. Periodic maintenance should be performed to realign the optics when necessary. If realignment is required more frequently than the recommended maintenance schedule, please contact Credence technical support.

Fiber Detection Area Alignment

Note: Fiber alignment is a Superuser function. See "Superuser Functions" on page 49.

- **To align the fiber,**

1. Get an image of the DUT using the low magnification lens by following the procedure: See "Starting Image Acquisition and Alignment" on page 46.
2. Move to a location on the DUT that is somewhat uniform in reflectance, such as a large metal pad and switch to the high magnification lens.
3. Ensure that a the image of the DUT location is well focused.
4. Enable the fiber cross-hair in Navigation mode by selecting Load detection circle from the Settings menu.
5. Select Fiber View from the Fiber Motion control panel.

6. The image of the optical fiber should appear in image view area as a bright circle.
7. If the optical fiber image does not correspond to the fiber cross-hair target, perform the procedure: See "To define the detection circle," on page 116.
8. Save the location and size of the circle by clicking the Settings menu Save detection circle command.

System Not Acquiring Data

1. Verify that there is power to the Nim bin.
2. Verify the trigger signal by checking the PTA start light. If illuminated go to step 3. If the start light is not illuminated, check for the trigger signal on an oscilloscope. Make sure the input impedance to the scope is 50 ohms. If the signal is not there then debug the origin of the trigger signal. If the signal is there check the amplitude against the current detector trigger threshold settings. Adjust setting if necessary. If still no start light, call technical support services for help.
3. Verify the span and offset settings in the Acquisition Settings control panel in Acquisition mode are correct when compared to those for the detector.
4. If there is still no data acquisition, call Credence technical support services for help.

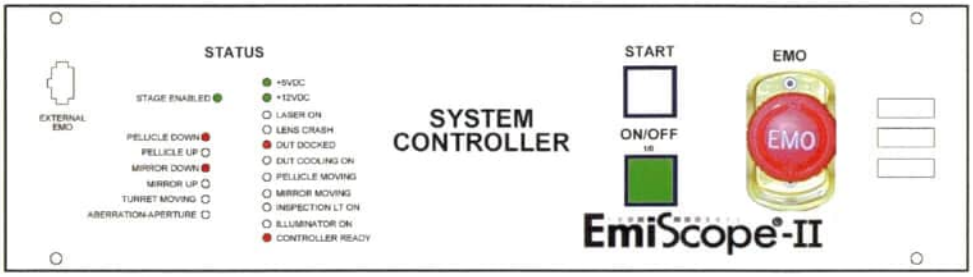
CHAPTER 4

EmiScope-II Controller

The EmiScope-II controller consists of a 19" rack mount drawer and a custom control pad which contains an stage interlock alarm and stage interlock override.

The EmiScope-II controller front panel provides the Main EMO. The Main EMO button is a push activated switch that will stop all motion and remove power from all subsystems in case of an emergency. Pressing the Main EMO button will cause a loss of all information stored in the detector and controller system. Data stored in the data acquisition buffer and stage controller will be lost and must be recovered after initialization. The Main EMO button must be reset prior to restoring power. Pull the Main EMO button out to reset it.

FIGURE 31. **EmiScope-II Controller Front Panel**



The EmiScope-II controller rear panel provides control and power to the rest of the system.

Using the Control Pad Functions

As of the EmiScope-II R4.5 and above software releases, all EmiScope-II controls are supported in the EmiScope-II software application. The only system functions on the control pad are Stage Interlock, see "Stage Interlock" on page 66 and Stage Interlock Override.

FIGURE 32. **EmiScope-II Control Pad with Stop Button**

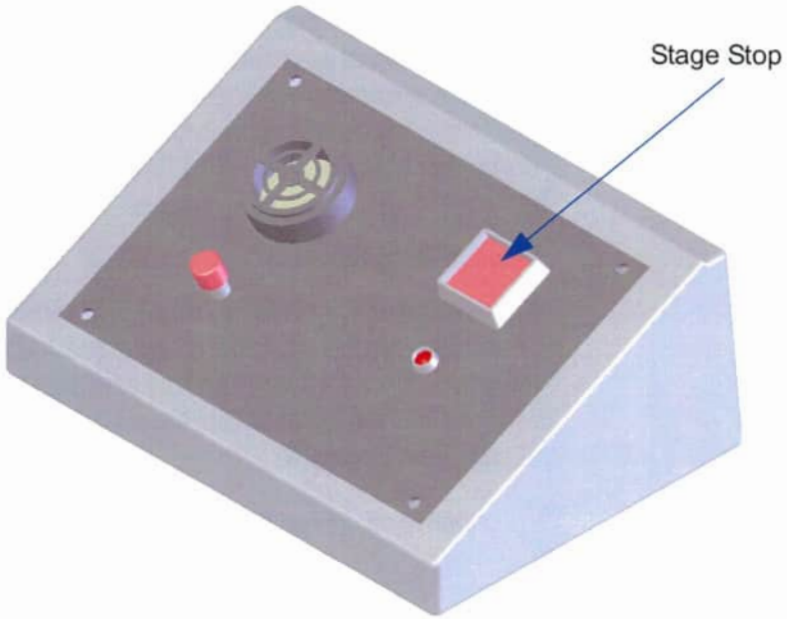
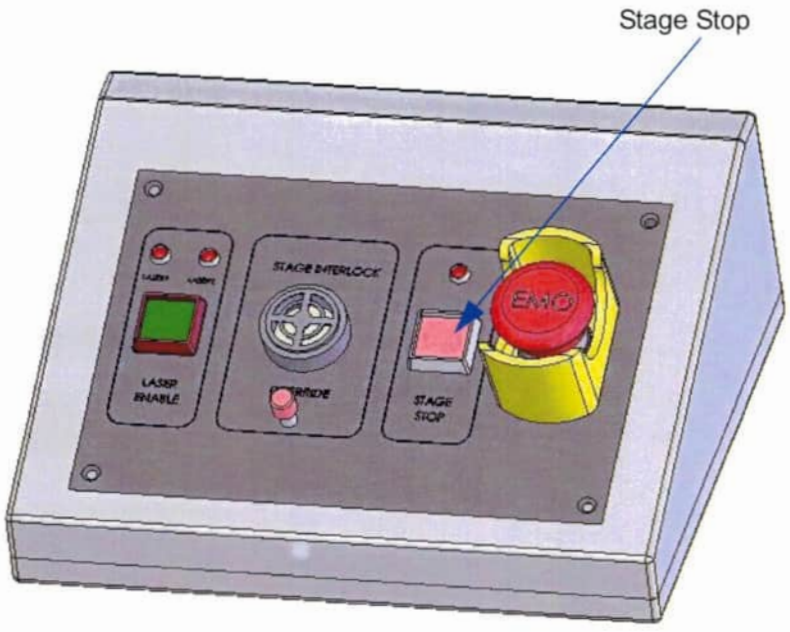


FIGURE 33. **EmiScope-II*t* Control Pad with Stop Button**



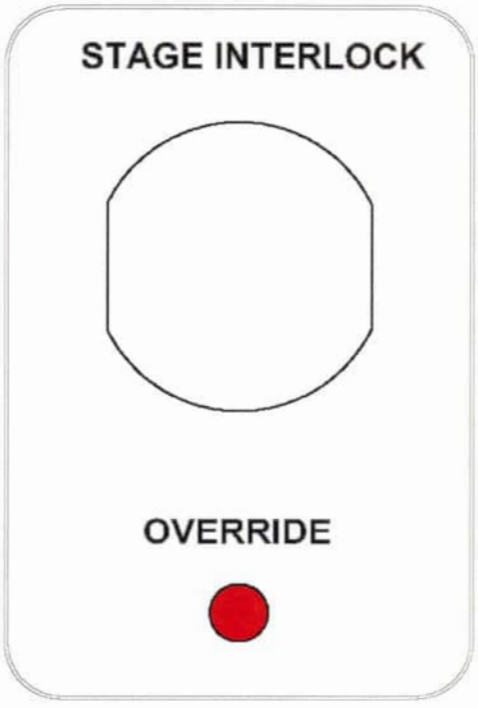
Stop Button

The EmiScope-II Stop button is located on the control pad and is push activated. It is provided to protect hardware due to stage or user failures. Pressing the control pad Stop button removes power from the stages and the turret controller. However, power is still present in the EmiScope-II controller. No information is lost when the control pad Stop button is pressed. However the stages may need to be re-initialized.

Stage Interlock

If the high magnification objective contacts an object, an alarm will sound. The control pad and the stages are locked out until the stage interlock is cleared. The Override button enables stage motion if the stage interlock is engaged. For more information on how to clear the crash see "Clearing a Crash" on page 29.

FIGURE 34. Stage Interlock Override



CHAPTER 5

Detector

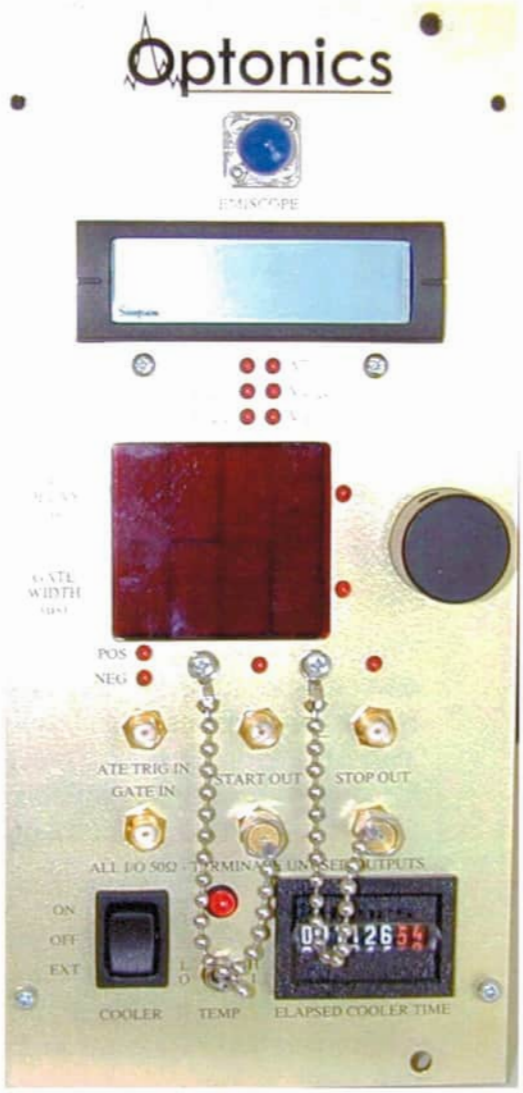
EmiScope-II contains a high speed, infrared photon counting detector. The detector module contains the detector, a cooling system and an LED read-out display. The inputs to the detector are through a 50Ω signal SMA trigger signal from the automatic testing equipment (ATE), an optical fiber connector, and an RS232 control port. The detector outputs are high speed start and stop analog signal through 50Ω SMAs designed to drive a picosecond timing analyzer (pTA).

All controls for the detector are handled through an RS232 control port or from the manual control on the detector front panel. The detector front panel contains a manual rotary encoder push button that is used to set and select parameters for display on an LED panel.

Note: With EmiScope-II R4.5 and above software releases, the EmiScope-II detector should only be controlled using the EmiScope-II software application.

Note: Detector power is obtained from the EmiScope-II system frame, and is switched on and off at the UEP 15 volt power supply.

FIGURE 35. Detector Front Panel



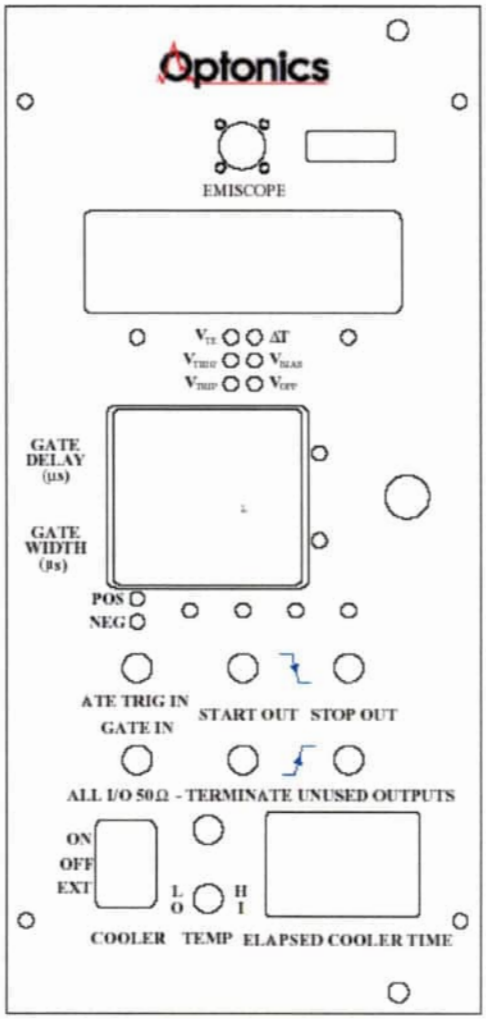
Using the Detector Manual Controls

Note: This section is for informational purposes only. As of EmiScope-II R4.5 and above software releases, all detector controls and settings should be performed from within the EmiScope-II software application.

The detector front panel control includes two toggle switches and a push button rotary encoder (see Figure 35). The bottom toggle switch controls

the thermal electric (TE) controller. The top toggle switches between the high speed temperature settings and low speed temperature settings. The higher temperature setting is used for short loop lengths (~<100 µs, >10kHz). The rotary control switch located on the right side in the middle of the panel is used to display and set the eight control registers.

FIGURE 36. Detector Front Panel Control



Two modes are toggled by pushing the rotary encoder,

- Display Mode
- Set Mode

Using the Display Mode

In addition to the Start and Stop lamps, the detector display mode has two or three solid lamps for the POS and NEG, and optionally for other parameters such as Gate Delay and Gate Width. See Table 7, "Detector Display and Set Mode Parameters," on page 70 for parameter definitions. The POS or NEG lamps indicates the trigger is on a rising or falling edge respectively. The six LCD panel at the top displays the currently selected parameter value.

- **To select which parameter to display or set,**

1. Rotate the rotary encoder switch until the lamp is illuminated for the parameter you want to display or set.
2. Press the rotary encoder switch to set a displayed parameter.

Using the Set Mode

Your EmiScope-II detector is factory programmed for optimal performance. Using the Set Mode to alter the detector parameters should only be performed by an Credence trained technician. If the detector parameters are inadvertently altered, power cycling the detector will reload the factory settings.

When the V_{TE} or DT lamp is flashing, you can rotate the switch and toggle the display of their values. Note that one of these lamps can be illuminated in Display mode and switching to Set mode may not allow you to toggle.

TABLE 7. Detector Display and Set Mode Parameters

Parameter	Definition	LCD Units
V_{TE}	Thermal electric cooler voltage	V
ΔT	Detector temperature	K (C)
V_{TRIG}	Trigger threshold voltage	V
V_{BIAS}	Detector bias voltage	V
V_{TRIP}	Detector threshold voltage relative to bias voltage	V
V_{OFF}	Detector OFF voltage relative to bias voltage.	V
Gate delay	Detector acquisition delay relative to trigger	µs

TABLE 7. **Detector Display and Set Mode Parameters (Continued)**

Parameter	Definition	LCD Units
Gate width	Detector acquisition gate width	µs
POS/NEG	Trigger edge polarity.	-
Start	Start event lamp	-
Stop	Stop event lamp	-

Cooler Power Switch

A power switch for the on board thermal electric (TE) cooler is located on the bottom of the front panel, and is the toggle switch labeled Cooler. Next to the cooler power toggle is an hour meter to record the accumulated time since the cooler was last powered up.

Temperature Switch

A two temperature toggle for the thermal electric (TE) cooler is located at the top of the front panel and labeled Light. This user selectable switch adjusts the detector performance for the trigger loop length being used. Select High temperature for loop lengths < 100µs and Low temperature for loop lengths > 100µs. The EmiScope-II software application should be terminated prior to changing the temperature switch. If the temperature switch is toggled from one mode to the other, allow ~15 minutes for the detector temperature to stabilize before acquisition.

Note: The detector automatically adjusts the bias voltage, V_{bias}, when setting the TE cooler temperature. The bias voltages vary and are factory programmed for your detector.

Installing the Detector

The detector module should only be removed or installed by a Credence trained technician.

Starting Up the Detector

This is the procedure to start up the detector after installation, upgrade or maintenance service.

- **To start the detector,**

1. Verify the water chiller unit is connected and running. The green LED on the water chiller front panel should be illuminated.
2. Verify TE cooler displays the temperature to be approximately zero.
3. Activate the trigger input source, ATE or other, and set the trigger input and polarity using the Acquisition Settings control panel in Acquisition mode. Verify that the detector start LED illuminates (brightness depends on trigger frequency). Verify that the start light is illuminated on the pTA.
4. Set the detector gate delay and gate width and set the pTA offset and span in the Acquisition Settings control panel in Acquisition mode.

CAUTION: Equipment damage is possible. Scratches and contamination to the fiber will cause significant sensitivity loss in the system. The fiber is polished and clean. Protect the fiber and fiber connections with covers when not in use. Dust off the fiber and connectors using only clean, dry air before mating.

Shutting Down the Detector

The detector will be properly shutdown during a normal system power down. The detector module should only be removed or installed by a Credence trained technician.

CHAPTER 6

Navigation Mode

Navigation mode in the EmiScope-II software application is used to display video information from the inspection camera and the microscope to perform DUT alignment, coarse and fine navigation, and system inspection during operations. You can view inside the system or from the image plane of the microscope, mark the image of the fiber on the DUT, change the contrast, brightness, and zoom of the image. Navigation mode is selected from the EmiScope-II software application. To launch the EmiScope-II software, see "Launching the EmiScope-II Software" on page 46.

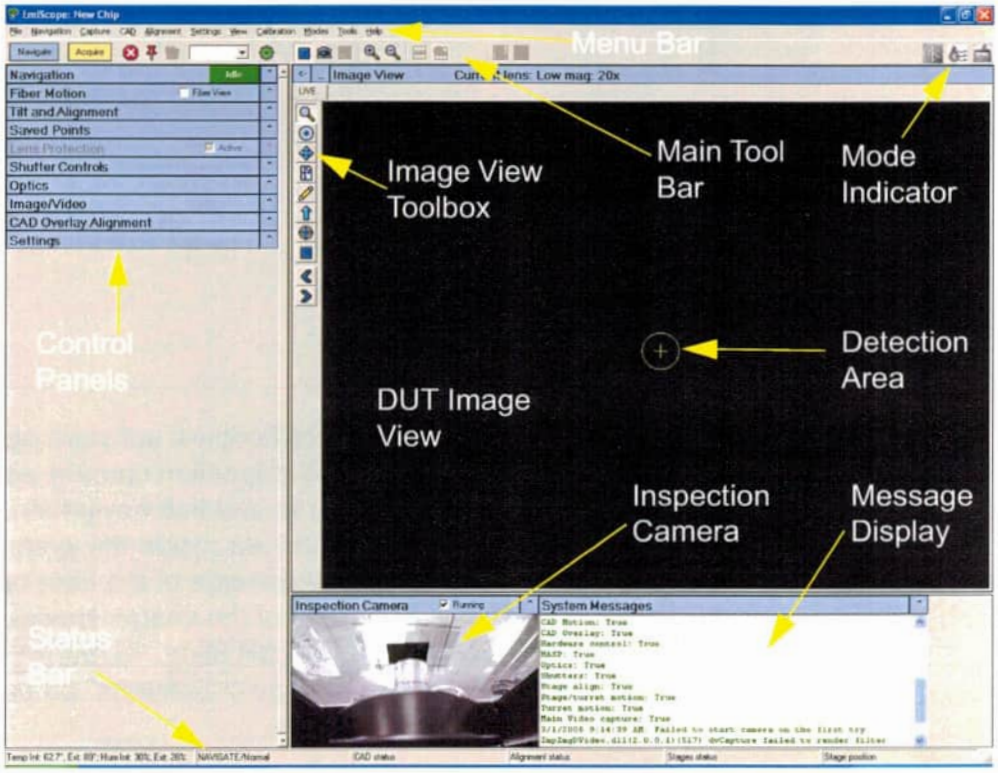
Navigation Mode GUI

The Navigation mode GUI is divided into eight functional areas,

- menu bar
- main tool bar
- DUT image view
- image view toolbox
- control panels
- status bar

- inspection camera
- message display

FIGURE 37. Navigation Mode



The Navigation mode menu bar consists of menus for capturing and viewing images, and changing settings. Certain menu commands have shortcuts in the main tool bar or image view toolbox.

TABLE 8. Navigation Mode Menu Commands

File	Create, load Chip Sessions, Print stored images, terminate or exit the software application.
Navigation	Move, initialize, save, stop the system stages and predefine step sizes for navigation panel arrow keys.

TABLE 8. Navigation Mode Menu Commands

Capture	Save and clear copies of the live image.
CAD	Establish connection with EGsoft CAD software application, move the stages to CAD locations, import and display CAD Overlay.
Alignment	Display CAD alignment panel and reset CAD alignment.
Settings	Enable and save the detection target area definition and define video settings.
View	Live image zoom in/out.
Calibration	Superuser functions for system calibrations.
Modes	Select system operation mode.
Tools	Enable/disable control panels display.
Help	For the software version number and contact information.

The main tool bar contains shortcuts for certain menu commands (Figure 38). On the right hand side of the tool bar, there are three mode indicators (Figure 39). The modes can be activated/deactivated from main menu under Modes. When a mode is activated, a green box will appear around the icon.

FIGURE 38. Navigation Mode Main Tool Bar

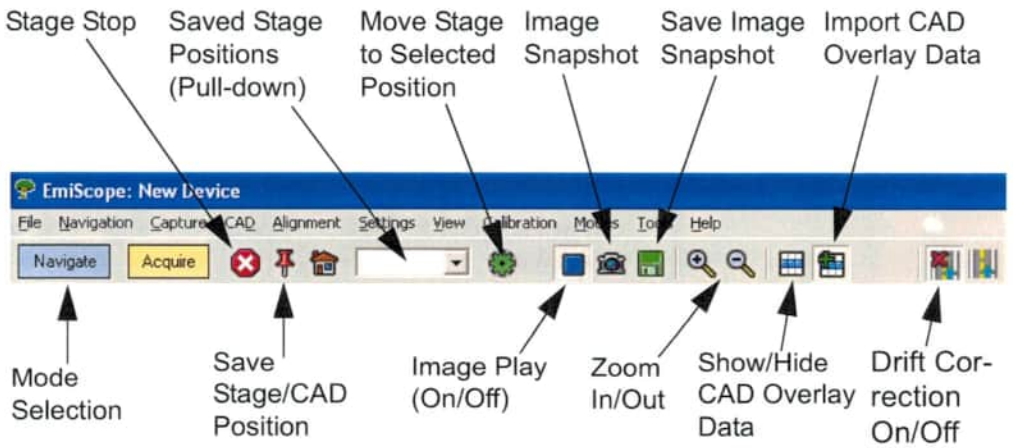


FIGURE 39. **Navigation Mode Main Tool Bar Indicators**

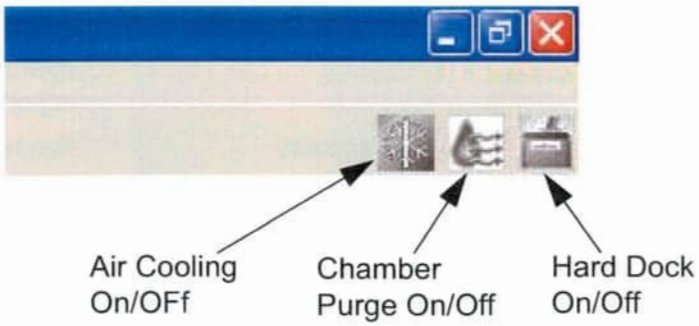


TABLE 9. **Navigation Mode Main Tool Bar Commands**

Mode Selection	Selects Navigation or Acquisition modes.
Stage Stop	Stops stage motion.
Save Stage/CAD Position	Stores either stage or CAD coordinates to user defined name.
Saved Stage Positions	Pull-down list of stored coordinates.
Move to Stage Position	Moves stages to position selected from pull-down list.
Image Play	Enables/disables live image display
Image Snapshot	Stores a temporary copy of the live image.
Save Image Snapshot	Stores temporary copy of the live image to disk directory.
Import CAD Overlay Data	Transfers outline display of current CAD position from EGsoft software to the EmiScope-II software application.
Show/Hide CAD Overlay Data	Enables/disables display of CAD Overlay data.
Drift Correction On/Off	Enables/disables drift correction function during data acquisition

Image Snapshot Feature

The snapshot feature allows you to store frames from the image view area. Although the IR camera size is always 320 x 240 pixels, the snapshot is resized to the image view area. If the image is zoomed to a factor > 1, the

snapped image will be cropped and resized to match the current image view area. The original frame (320 x 240) is interpolated using one of three user selectable methods: Nearest Neighbor, Bilinear, Bicubic.

You can change the snapshot setting by clicking the Settings menu and selecting the Snapshot Options command.

When an image is resampled, an interpolation method is used to assign values to any new pixels it creates, based on the values of existing pixels in the image. The more sophisticated the method, the more quality and detail from the original image are preserved.

To set the Interpolation scheme, choose one of the following options:

- Nearest Neighbor (Jagged) for a fast but less precise method. This method is recommended for preserving hard edges and produce a smaller file. However, this method can result in jagged effects, which become apparent when distorting or scaling an image or performing multiple manipulations on a selection.
- Bilinear for a medium-quality method.
- Bicubic (Smooth) for a slower but more precise method, resulting in the smoothest tonal gradations.

Automatic Drift Correction

During longer histogram acquisitions, the image of the DUT may drift in X, Y, or Z, usually due to DUT thermal instability. The Automatic Drift Correction(ADC) function is used to compensate for any drift of the DUT during data acquisition by using image recognition to maintain X, Y, and Z positioning. This feature is useful when you need to acquire a data over a long period of time. The drift correction is performed by periodically interrupting the histogram acquisition, checking the location of a selected image template, and moving the stage, shutter, and fiber to a new location to ensure the optimal collection of photons at the desired location.

♦ **To use Automatic Drift Correction,**

1. Activate the drift correction in either Navigation or Acquisition mode.
2. Start the drift correction by clicking the Drift Correction On/Off icon in the tool bar. The program will take you to the next step - select an image

template in the DUT image view using the Rectangle Measurement tool in the Image View Toolbox, see Figure 67 on page 115.

3. If the process is started in Navigation mode, the system will automatically switch to Acquisition mode and begin acquiring data.
4. After the set interval time (default is 5 minutes), the system automatically pauses acquisition, and switches to Navigation mode to check the current image location against the image template. If there is any drift, the system will adjust the stage and fiber to the correct location, and data acquisition will automatically resume.
5. A snapshot of the histogram will be taken before each drift correction.
6. Automatic Drift Correction can be enabled at any time during data acquisition.

Navigation Mode Control Panels

The control panels for Navigation mode are used for DUT navigation, setting image viewing parameters, storing DUT locations of interest, controlling the shutters, defining lens protection areas, and adjusting the CAD Overlay. Control panels can be opened, closed, and floated on top of the EmiScope-II software application. Clicking on a closed control panel heading will open the control panel in its current location. Clicking on an open control panel heading will close the panel. Clicking on a control panel carat, ^, will float the panel on top of the software application. Floating panels can be placed anywhere on the desktop. To close a floating panel, click the panel's X icon.

Navigation Control Panel

The Navigation control panel is used to position the EmiScope-II stages over a particular transistor of interest on the DUT. Navigation can be performed using either stage coordinates or CAD coordinates. When navigating with CAD coordinates, the X and Y CAD position entered is used to move the stage when the system is aligned to a CAD database. A three point alignment must be set prior to using CAD coordinates for navigation. The Navigation control panel will change appearance when using the solid immersion lens.

FIGURE 40. Navigation Control Panel without SIL

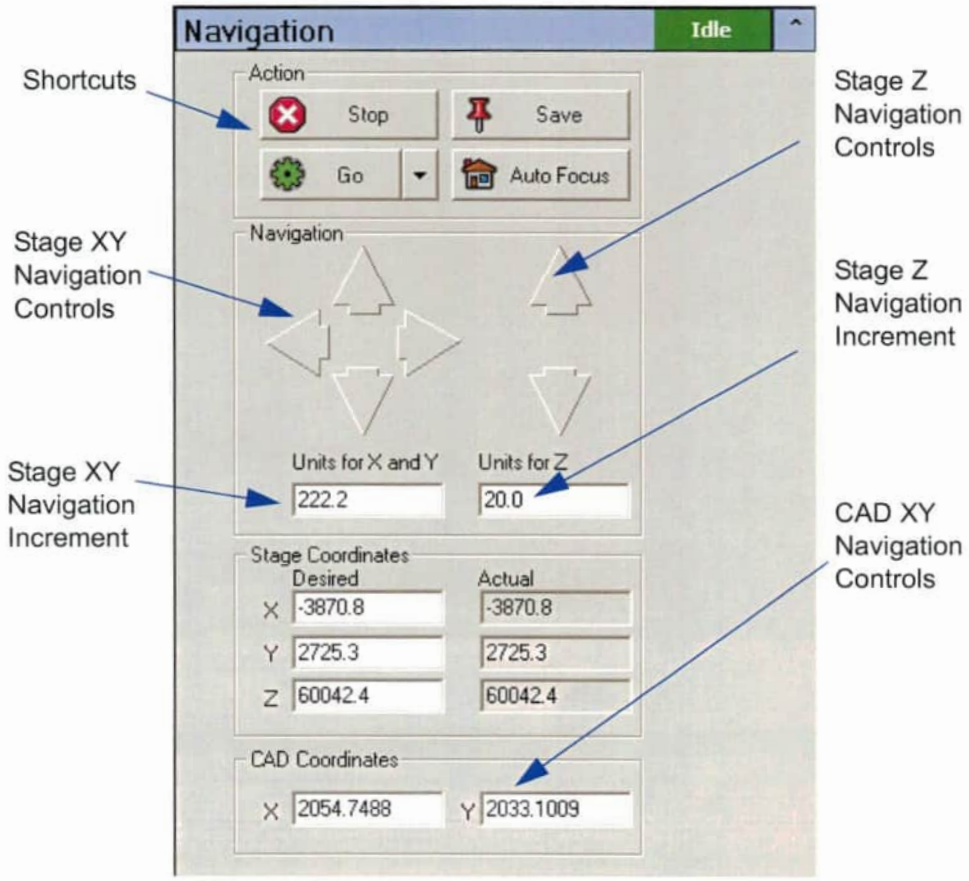
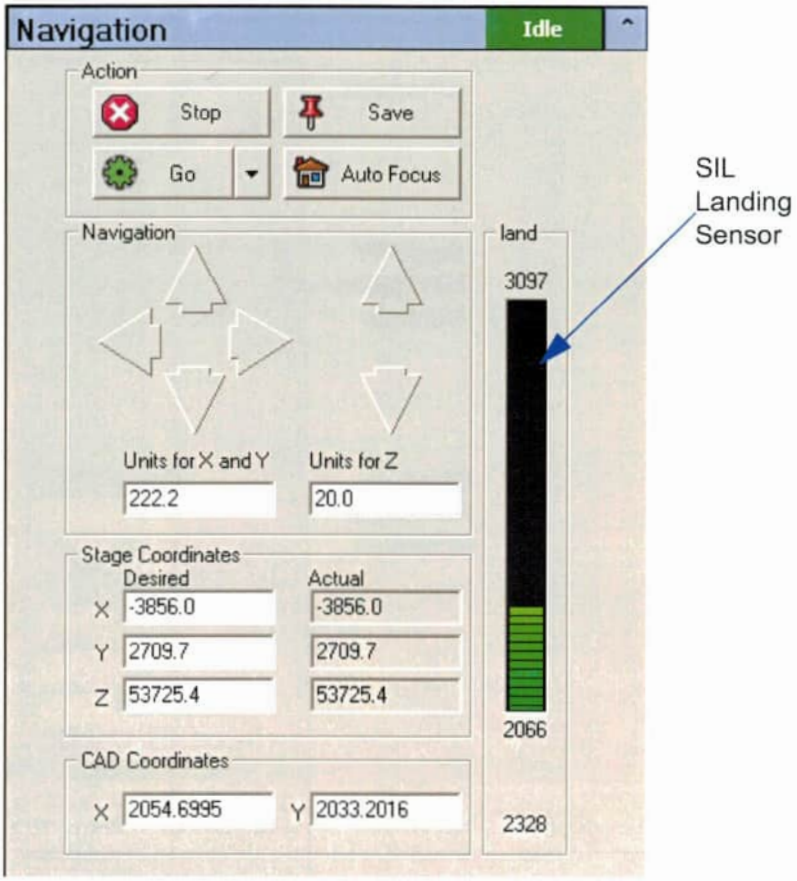
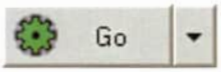


FIGURE 41. Navigation Control Panel with SIL



The Navigation control panel contains several shortcuts.

TABLE 10. Navigation Control Panel Shortcuts

	The Go shortcut is used to move the stages to user stored locations, see Save shortcut. Locations are stored using either Stage Coordinates or CAD Coordinates panels and appear in the Go button drop down list.
	The Stop shortcut is used to immediately stop the movement of the stages.
	The Auto Focus shortcut performs an automatic image focus routine. Use this shortcut after first manually focussing on the DUT, and when moving to a new location. Only use automatic focus when the image is slightly out of focus.
	The Save shortcut stores current stage or CAD coordinates to a user defined unique name.

Initializing the XYZ Stages

Whenever the EmiScope-II system is powered on and the EmiScope software application is first launched, the system controller and the stages perform an initialization sequence. The stage controls in the Navigation panel are disabled until this sequence is complete. When the initialization sequence is complete, a message is displayed acknowledging that the system is initialized. Stage initialization can be initiated by selecting either the Initialize command from the Navigation menu or by selecting the Home shortcut on the Navigation mode main tool bar.

If the stage controller is already initialized, you can keep the CAD alignment and stored stage positions from a previous session.

Note: Initializing the stages is a Superuser function. See "Superuser Functions" on page 49.

Using the Coordinate Displays

You can operate the stage from the Navigation panel using two coordinate systems:

- Stage Coordinates
- CAD Coordinates

Enter CAD X and Y coordinates in the CAD navigation controls to move the stage using CAD coordinates when the system is aligned to a CAD database. A three point alignment must be performed prior to using CAD coordinates for navigation. For more information on this setting see "DUT Navigation" on page 82.

The stage navigation coordinates are color coded:

TABLE 11. Stage Coordinates Color Coding

Black	The stage has reached the location where all three coordinates match the user definition.
Red	Indicates the stages in motion.
Yellow	The controller is reporting a completed motion, but the stages are not at the desired locations. Stages must be initialized if the controller remains in this condition.

DUT Navigation

You can save transistor location coordinates and define the step movement sizes for the stage arrow controls of the Navigation panel.

Saving Locations

You can save and name specific locations of interest in order to return to them without re-typing their coordinates. Saved locations are displayed in the Saved Points control panel and the main tool bar pull-down list.

- **To save locations,**

1. When in Navigation mode, use the stage arrow buttons to move to the location you want to save.
2. Click on the Navigation menu and select the Save Location command or use the Save shortcut.
3. Type in a unique name for the location and select to store the location using stage or CAD coordinates.

Creating Predefined Steps

You can define the step sizes that correspond to stage control arrows increments.

- **To define the step sizes,**

1. Click on the Navigation menu and select the Set Predefined Steps command.
2. Type the step sizes you want, separated by commas. The predefined steps apply to X, Y, and Z stage increments.
3. To select a predefined step size in the Navigation control panel, place the cursor over a stage control arrow and hold down the right mouse button. The list of predefined steps will appear. Select the desired stage movement increment. The increment selected will be placed in the Navigation control panel increment area. Any subsequent click of a stage control arrow button will move the stage by the desired increment.

Three Point CAD Alignment

The EmiScope-II software provides a 3-point alignment feature in order to utilize DUT navigation using CAD coordinates instead of the stage coordi-

nates. This procedure can be used in conjunction with the FEI Knight's CAD software package, or for aligning the stage to user defined coordinates.

Note: The 3-point CAD alignment procedure must be performed using the low magnification lens on the EmiScope-II system.

- **Using the FEI Knight's application.**

1. If the FEI Knight's software is being used, it must be connected to the EmiScope-II software prior to the alignment procedure. The FEI Knight's software operates on an external Sun workstation in a UNIX environment and is licensed by FEI Knight's. To obtain an EmiScope-II software compatible FEI Knight's license, contact Credence technical support.
2. To allow a connection between the FEI Knight's software and the EmiScope-II software, three environmental variables must be defined on the Sun workstation prior to executing the FEI Knight's software application.

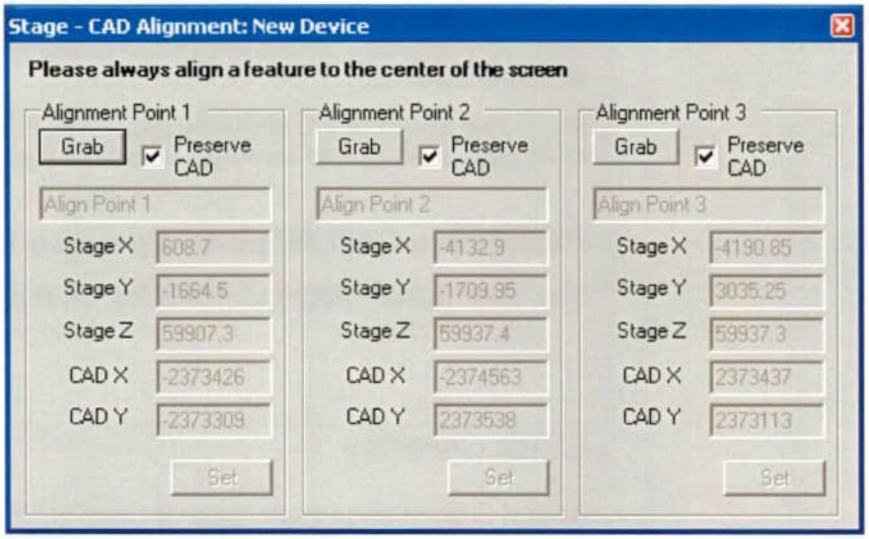
TABLE 12. FEI Knight's Environmental Variables

K_Server_Addr	Set to the IP address for the EmiScope-II system PC.
K_Server_Port	Set to 52000 which is unique to the EmiScope-II connection.
K_MESSAGE_DISPLAY	Optional. Set to 1 to disable FEI Knight's message reporting during polygon transfer. By setting to 1, polygon transfer speed is increased.

- **To start the alignment procedure,**

1. Obtain an image of the DUT using the low magnification lens. Select an identifiable feature in the 100x image field of view and position the feature in the center of the image view area. The feature selected should be near a corner of the DUT. If using the FEI Knight's software, position the same DUT image feature in the center of the CAD window.
2. Open the Alignment->Set Alignment Point window.

FIGURE 42. CAD Alignment Window



3. Click the Grab button to capture the X, Y, and Z stage coordinates. The EmiScope-II software will automatically enter the stage coordinates in the Alignment window. If the EmiScope-II software is connected to the FEI Knight's CAD software, then the Grab button will automatically capture and enter the current CAD X, Y coordinates. If the FEI Knight's software is not being used, the CAD X and Y coordinates must be entered manually. Click the Set button to save the first alignment point.
4. Move the stage to a second identifiable DUT location near a different corner of the DUT. Again open the CAD Alignment window and click the Grab button to automatically capture the stage and CAD coordinates. Click Set to save the second alignment point.
5. Move the stage to a third identifiable DUT location near a different corner of the DUT. Again open the CAD Alignment window and click the Grab button to automatically capture the stage and CAD coordinates. Click Set to save the final alignment point.
6. Upon completion a message box will let you know that the three point alignment was successful and the CAD coordinates are activated in the Navigation control panel.

7. Any of the individual alignment points can be altered or redefined by using the Grab and Set buttons for the desired point.

Note: It is required to use the center of the image view for defining the CAD alignment points.

Note: The EmiScope-II software application will automatically name the three CAD alignment points as Align Point 1, Align Point 2, Align Point 3.

Performing CAD Alignment using a Stored Chip Session

See See "3-point Alignment Wizard" on page 103.

CAD Overlay

After a 3-point alignment is performed, CAD Overlay can be used. The CAD Overlay is an outline of the polygons in the current FEI Knight's CAD window location placed on top of the live image view. To transfer the FEI Knight's CAD window polygons, use the Import CAD Data selection from the CAD menu or use the main tool bar shortcut. After the CAD data is transferred, use the Show/Hide selection from the CAD menu or use the main tool bar shortcut to enable/disable the CAD data display.

- The CAD Overlay controls are only activated after performing a 3-point alignment.

Optics and Image/Video Control Panels

The Optics and Image/Video control panels are used to define live imaging parameters, set live image filtering, and select the lens to be used for imaging.

FIGURE 43. **Optics Control Panel**

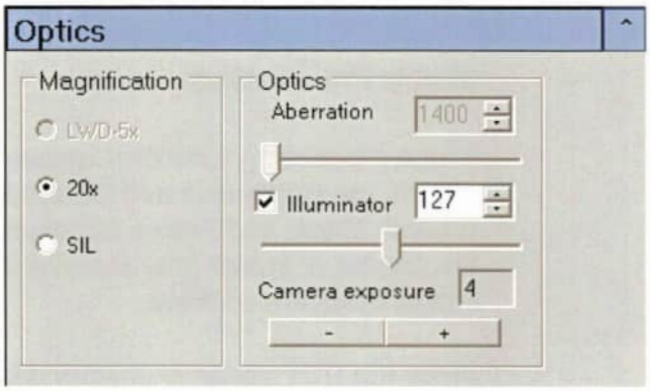
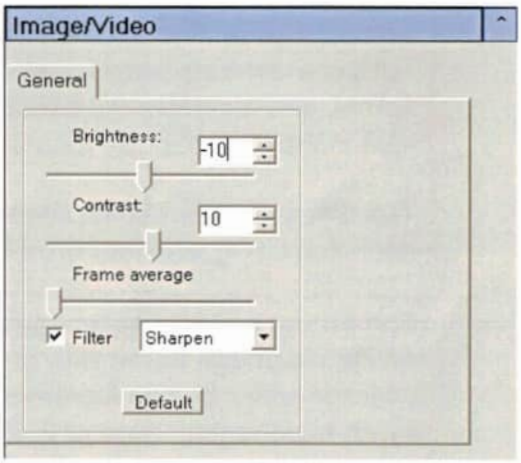


FIGURE 44. **Image/Video Control Panel**



Optics

The Illuminator check box enables/disables the DUT image illumination source. Use the Illuminator slider to increase or decrease the degree of image illumination.

The Camera exposure setting is used to increase or decrease the DUT imaging camera sensitivity. Use the -/+ buttons to change the Camera exposure. Increase the Camera exposure setting if the Illuminator slider is

at maximum and the DUT image is too dark. Decrease the Camera exposure setting to decrease the sensitivity of changing the Illuminator setting.

Image Processing

Image processing functions located in the Image/Video control panel include the Brightness and Contrast sliders, the High pass, Sharpen, and Smooth filters, and Frame averaging. Use the Brightness slider to control the degree of image gray scale, and use the Contrast slider to change the image light/dark contrast.

Since the DUT image is digitally captured and displayed, the image is composed of individual pixels. The individual image pixels are more evident when zooming into the live image. The Smooth filer can be used to reduce the image pixilation.

The High pass filter retains edge details where sharp transitions occur and removes low-frequency detail in an image. It is a 2D convolution with a 3 x 3 kernel, and creates a 3D effect or feeling which causes the appearance of a shift in the image, however, no image shift actually occurs.

The Sharpen filter uses a linear transform function to increase feature edge definition using adjacent pixel information.

The Frame average slider uses a temporal average function to average the entire live image frame with previous image frames. Increasing the frame average slider by one increment increases the number of frames averages by an exponential value of 2. If the slider is at minimum, there is no image averaging. Increasing the slider by one increment averages 2^1, or 2, image frames. Increasing by another increment averages 2^2, or 4, image frames, and so on up to a maximum of 2^{64} image frames.

Note: If large values of frame averaging are used, the image update time will be increased.

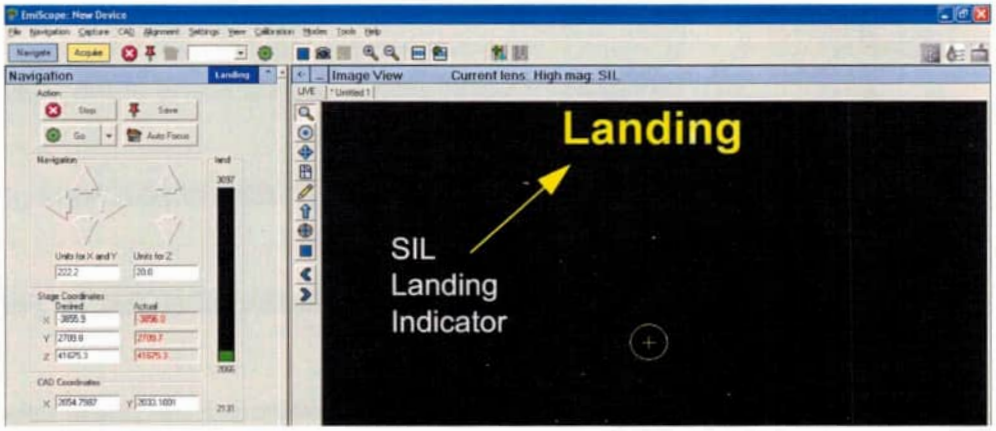
Magnification and SIL Landing

Selecting the 20x radio button engages the use of the 20x lens. Selecting the SIL radio button engages the use of the Solid Immersion Lens. When switching lenses, the Z stage automatically goes to home, or 0, position

before switching to clear the DUT. After switching, the Z stage automatically returns to the previous Z location.

- When imaging a DUT for the first time, the 20x lens must be used to first obtain an image of the DUT. Then after performing Table Tilt, see "Tilt and Alignment Control Panel" on page 97, switching to the Solid Immersion lens is desirable for higher resolution imaging and for photon data collection.
- When switching to the SIL, the Z stage will be automatically incremented until the SIL landing sensor produces a readback, see Figure 41 on page 80. During the SIL landing procedure, an obvious indicator will appear in the image view area. See Figure 45. At this point, the SIL is in contact with the DUT. Prior to contact, there will be no DUT image in the DUT image view area. After SIL landing, it may be necessary to manually focus using small(< 10 μm) Z stage increments to produce the highest quality DUT image.
- When changing XY location while using the SIL, the SIL will automatically retract from contact with the DUT and move to the desired XY location. Then, the SIL will automatically contact the DUT at the new location, and the SIL landing sensor will display a reading. After SIL landing, it may be necessary to manually focus using small(< 10 μm) Z stage increments to produce the highest quality DUT image.

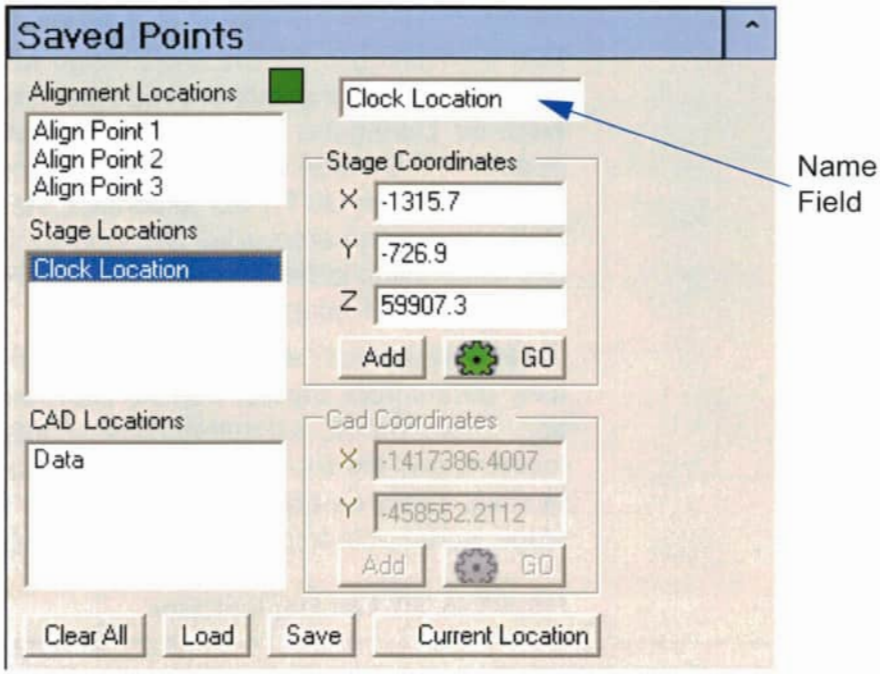
FIGURE 45. SIL Landing Indicator



Saved Points Control Panel

The Saved Points control panel is used to manage CAD alignment points, saved stage location, and saved CAD locations.

FIGURE 46. Saved Points Control Panel



Alignment Locations contains a listing of the current 3-point CAD alignment locations.

Stage Locations contains a listing of all current positions that were stored using stage coordinates.

CAD Locations contains a listing of all current positions that were stored using CAD coordinates.

When a stored location is selected, the name appears in the name field and the stored coordinates are displayed in the Stage Coordinates and/or CAD Coordinates fields.

To save the current location, click the Current Location button, and the stage and CAD coordinates for the current location are automatically entered in the respective fields. Type a unique name into the name field. Click the Add button in the Stage Coordinates section to save the location using stage coordinates. Click the Add button in the CAD Coordinates section to save the location using CAD coordinates.

- CAD coordinates can only be saved after performing a 3-point CAD alignment. See "Three Point CAD Alignment" on page 83.

Clicking the Go button in either the Stage Coordinates section or the CAD Coordinates section will move the stage to the currently selected location.

Use the Save button to store all locations to a file on disk.

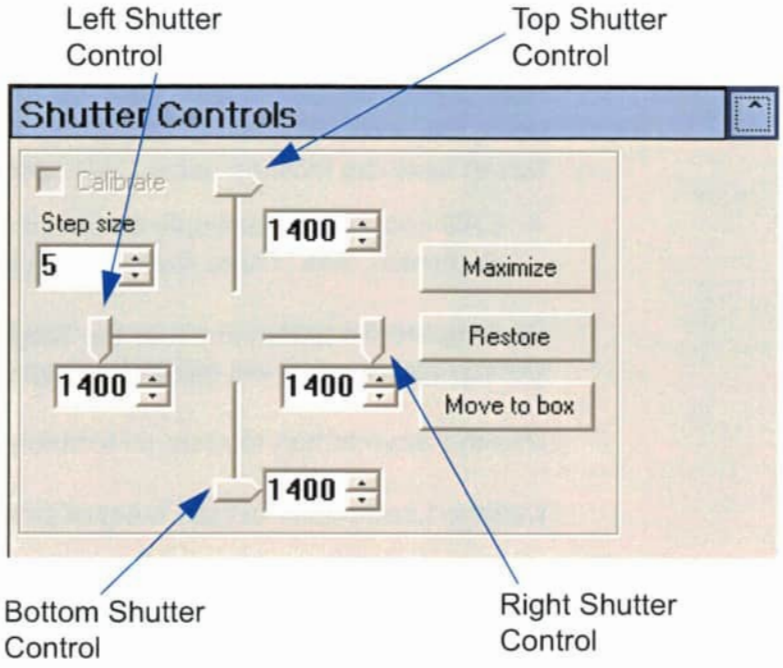
Use the Load button to load a set of stored locations from a file on disk.

The Clear All button with remove all stored stage and CAD locations, but will not clear the 3-point alignment.

Shutter Controls Control Panel

Use the system shutters to form a variable aperture around a DUT region for photon data collection. The shutters allow for restricting photon data collection to the area defined.

FIGURE 47. **Shutter Controls**



There are four individual shutters, top, bottom, right, left. Each shutter has a movement slider in the Shutter Controls panel. Adjusting a shutter movement slider with bring that shutter into the image view. Use all four shutters to form an aperture around an area of interest for photon data collection.

The Step size defines the shutter movement increment when moving the shutters with the arrow control buttons. A step size of 10 is an approximate 0.30μm increment.

Clicking the Maximize button immediately maximizes, or fully extends, all four shutter positions which moves the shutters out of the image view.

The Restore button closes all four shutters to the last set position prior to clicking the Maximize button.

The Draw Aperture button moves all four shutters to a box defined using the Draw Aperture control in the Image View Toolbox. See Figure 67 on page 115.

Note: The shutters must be calibrated prior to using the Draw Aperture command.

- The shutter Calibrate function is a Superuser function to define known shutter positions using a five step method for each shutter, and is performed prior to automatically moving the four shutters to a software drawn aperture.

Note: Initializing the stages is a Superuser function. See "Superuser Functions" on page 49.

♦ **To calibrate the shutters,**

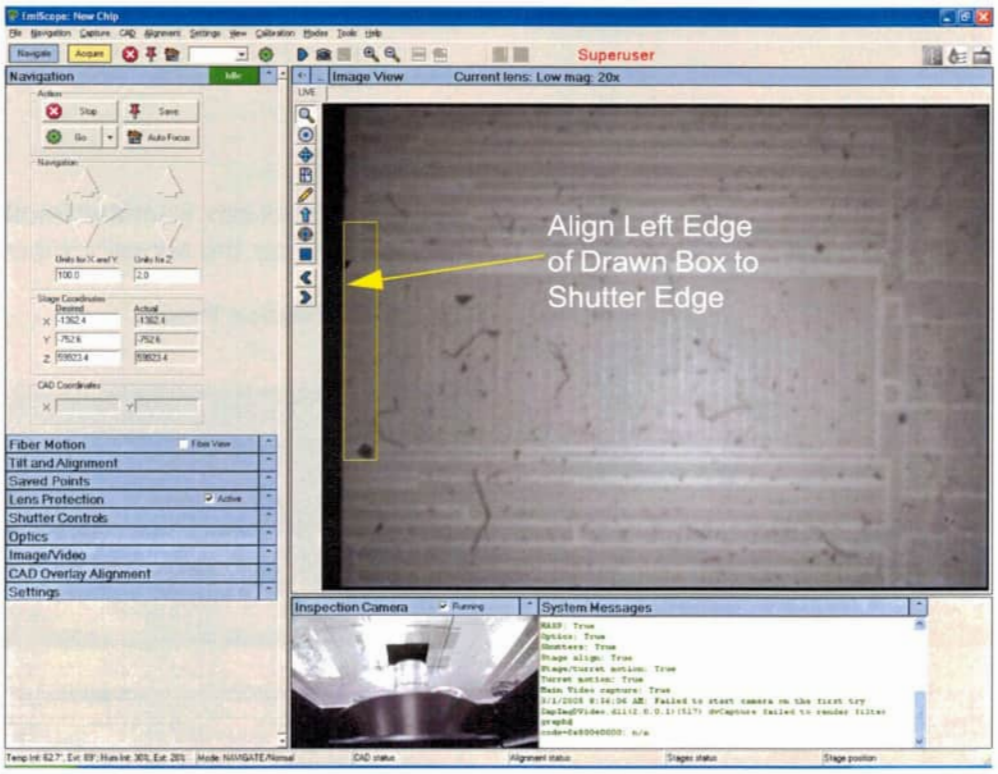
1. Logon as Superuser.
2. Maximize the shutters.
3. Select the Calibrate check box from the Shutter controls panel, and the panel will update to display the shutter calibration.

FIGURE 48. Shutter Calibration Panel

4. Select the Left Shutter and select Go for Step 0 calibration. The left shutter will move to the predefined Servo location. Step 0 should bring the left shutter just into the image view. If the shutter is not visible, increase the Servo location for Step 0. If the Servo location for Step 0 is increased, all Servo locations for Step 1 through Step 4 will be automatically recalculated.

5. In the image view, use the left mouse button to draw a box at the location of the Step 0 shutter position. The left edge of the drawn box should be aligned with the shutter edge. See Figure 49.

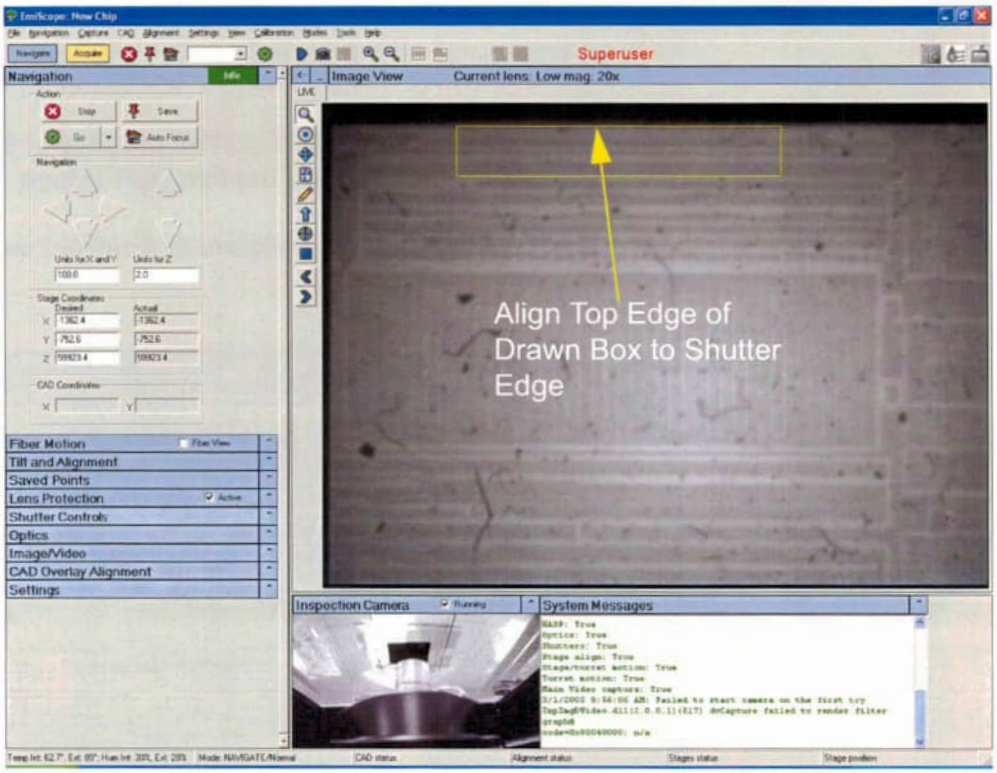
FIGURE 49. Shutter Calibration, Left Shutter, Step 0



6. After drawing a box aligned with the shutter edge, the image pixel value of the left edge of the drawn box will be automatically entered in the shutter calibration Pixel text box.
7. Repeat the procedure for Step 1 through Step 4 for the Left shutter.
8. After completion of the Left shutter calibration, select the Top shutter from the shutter calibration panel, and select Go for Step 0 calibration. The top shutter will move to the predefined Servo location. Step 0 should bring the top shutter just into the image view. If the shutter is not visible, increase the Servo location for Step 0. If the Servo location for Step 0 is increased, all Servo locations for Step 1 through Step 4 will be automatically recalculated.

9. In the image view, use the left mouse button to draw a box at the location of the Step 0 shutter position. The top edge of the drawn box should be aligned with the shutter edge. See Figure 50.

FIGURE 50. Shutter Calibration, Top Shutter, Step 0



10. After drawing a box aligned with the shutter edge, the image pixel value of the top edge of the drawn box will be automatically entered in the shutter calibration Pixel text box.
11. Repeat the procedure for Step 1 through Step 4 for the Top shutter.
12. Repeat the procedure for the Bottom and Right shutters.

Note: For proper shutter calibration, always use the left edge of the drawn box for the Left and Right shutters, and use the top edge of the drawn box for the Top and Bottom shutters.

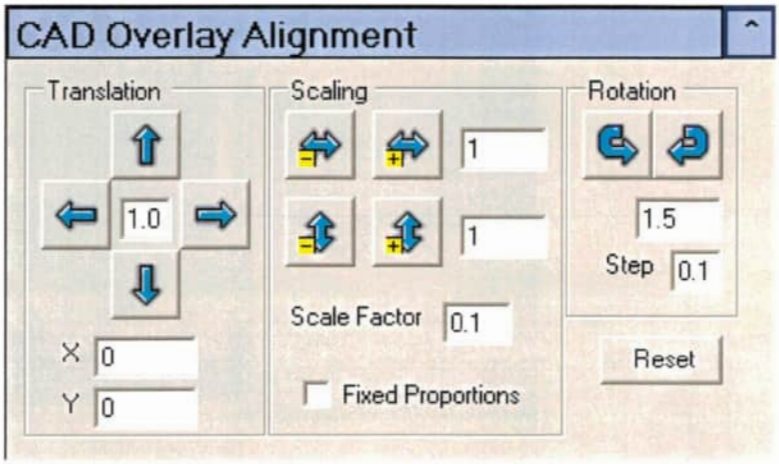
Lens Protection Control Panel

The Lens Protection control panel is used to define safe ranges of travel for the X, Y, Z stages. See "Setting Up the Lens Protection File" on page 53.

CAD Overlay Alignment Control Panel

The CAD Overlay Alignment control panel is used to make adjustments of the CAD Overlay relative to the live DUT image.

FIGURE 51. CAD Overlay Alignment Control Panel



Use the Translation arrow buttons to move the CAD Overlay in X and Y. The degree of movement is defined by pixels. Increase or decrease the amount of pixels for movement by adjusting the number in the center field of the Translation arrows.

Use the Scaling arrow buttons to resize the CAD Overlay in X and Y. The amount of scaling is determined by the Scale Factor field. Select the Fixed Proportions check box to scale the CAD Overlay equally in both X and Y directions.

Use the Rotation buttons to rotate the CAD Overlay either clockwise or counterclockwise by the amount defined in the Step field.

The Reset button will set all CAD Overlay alignment parameters to their default settings.

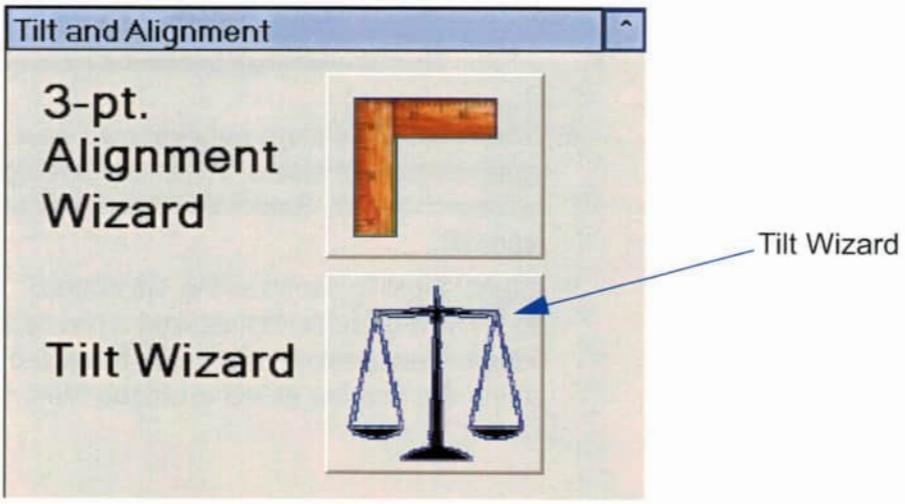
Tilt and Alignment Control Panel

The Tilt and Alignment control panel contains two wizards: Tilt Wizard and 3-point Alignment Wizard.

Tilt Wizard

The Tilt Wizard is used in conjunction with the Solid Immersion Lens(SIL). Before using(landing) the SIL, the EmiScope-II system should be aligned to the DUT using the Tilt Wizard. The SIL is sensitive to non-planarity with respect to the device under test. By using a low power, visible laser source, the EmiScope-II table top insert is tilted to correct for a non-planar device surface. The Tilt Wizard should be used prior to any SIL landing to verify DUT planarity.

FIGURE 52. Table Tilt Control Panel



♦ **To perform table tile using the Tilt Wizard,**

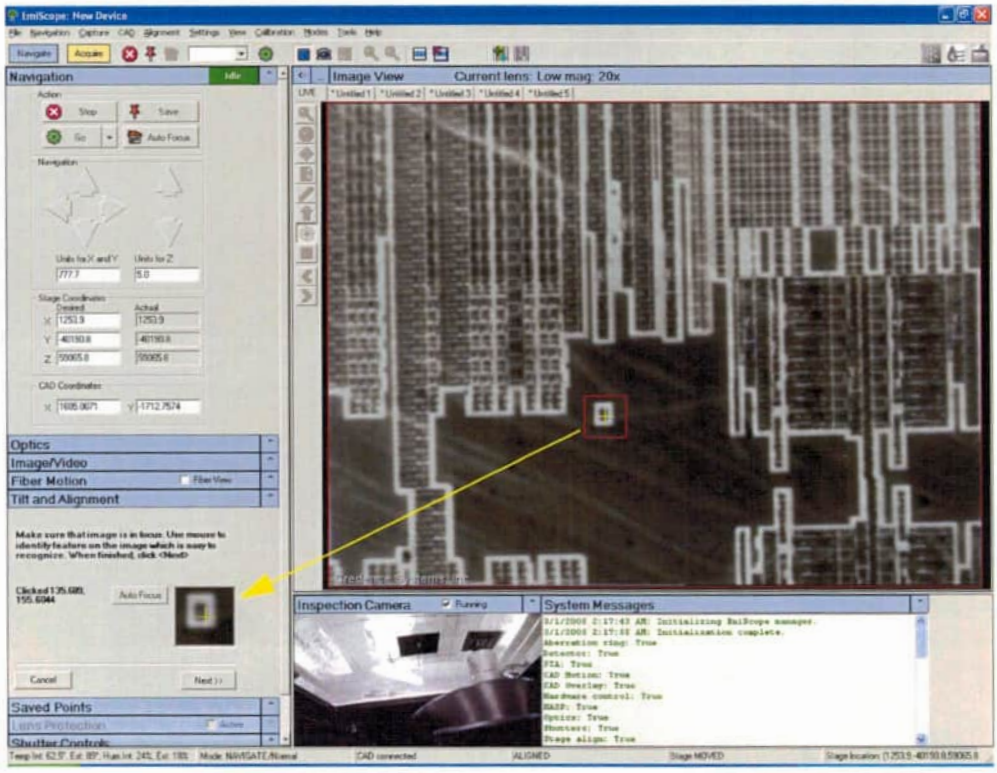
1. Navigate to the DUT location of interest using the Low magnification lens.
2. Select the Tilt Wizard icon.
3. The Tilt and Alignment control panel will update with the initial screen. See Figure 53 on page 98.

FIGURE 53. Tilt Wizard Initialization

Tilt and Alignment
Tilt and Alignment
You are about to start Tilt procedure. During this process the system will lose 3pt alignment (if present). Please choose if you want to realign the system after the procedure finishes.
Chip info loaded: New Device
3pt Alignment is OK
Redo 3pt Alignment after Tilt procedure
Is it possible to recognize a feature on Low mag image on this chip?
Cancel
Next >>

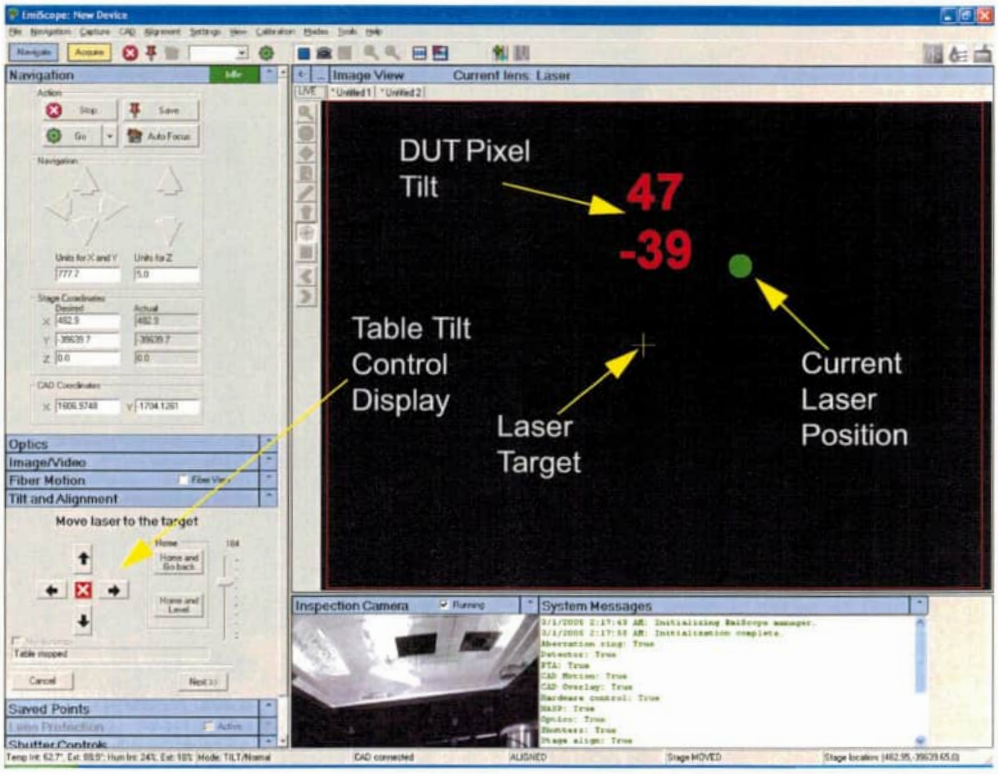
4. The initial Tilt Wizard panel shows your Chip Session information and 3-point alignment status. When performing table tilt, your 3-point alignment will be changed. Select the check box to use rapid 3-point alignment after tilt.
5. Select Next to continue the Tilt Wizard. The Tilt Wizard panel will update to allow feature selection, and a red selection box will appear in the image view area. At this point, focus the device image if necessary, then using the mouse, select a unique feature in the device image.

FIGURE 54. Tilt Wizard Feature Selection



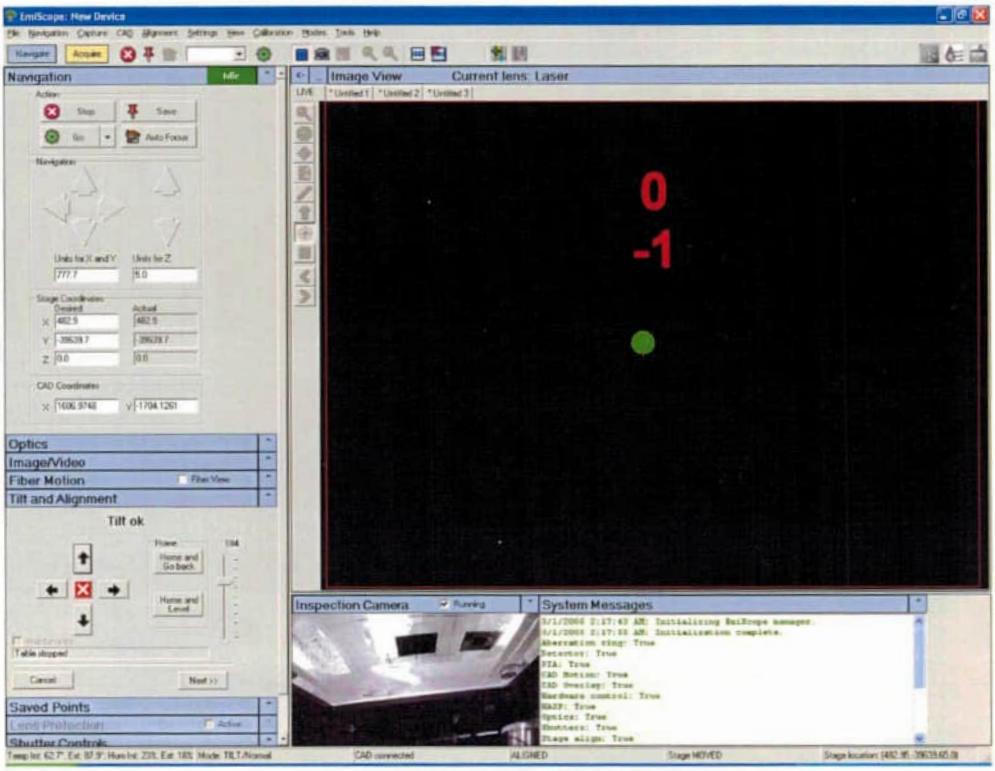
6. When an image feature is selected, the image information contained within the red selection box will be displayed in the Tilt Wizard panel. This feature will be used to relocate the image view after device tilt is performed.
7. Select Next to continue the Tilt Wizard. The EmiScope-II system will automatically switch from the 20x lens to the laser source.

FIGURE 55. Tilt Wizard Laser Source



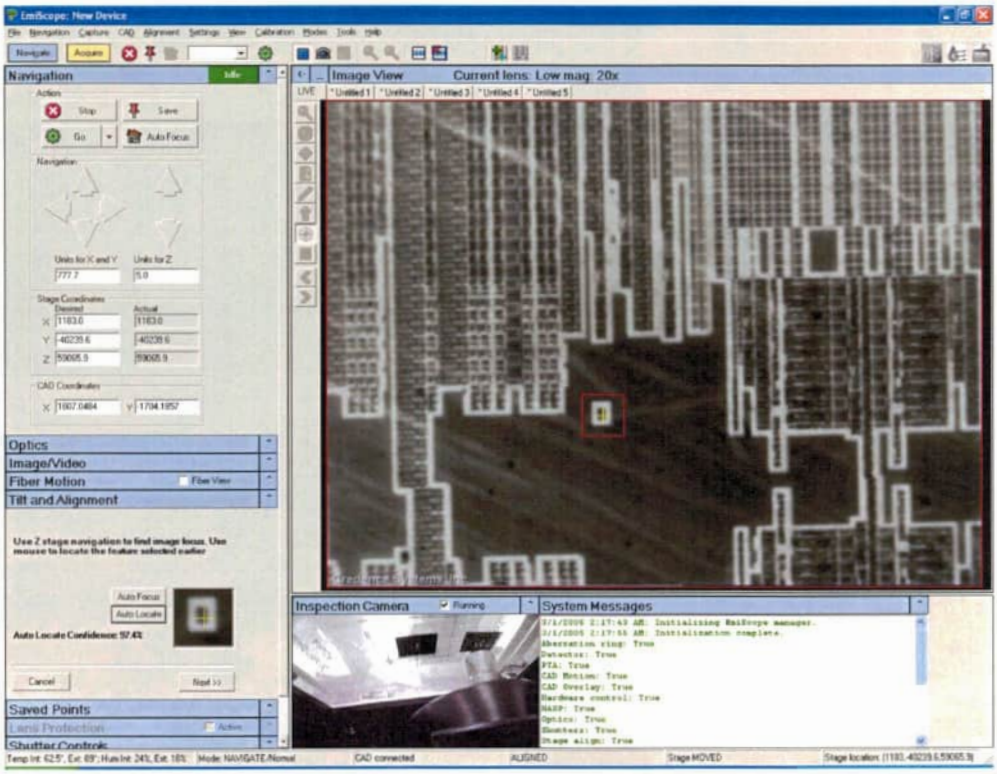
8. The image view area will be changed to display the laser target, current laser position, and the tilt of the DUT in pixels. The Tilt Wizard will update to the display representations of the table tilt controls. Tilt the table by click the left/right and up/down arrows. The laser position and DUT pixel tilt in the image view area will update while adjusting the tilt control arrows.
9. When the tilt control arrows are adjusted to the correct position to compensate for DUT tilt, the display representation will indicate OK, the laser position will be on the laser target, and the DUT pixel tilt will be at or near zero. See Figure 56 on page 101.

FIGURE 56. Table Tilt Aligned



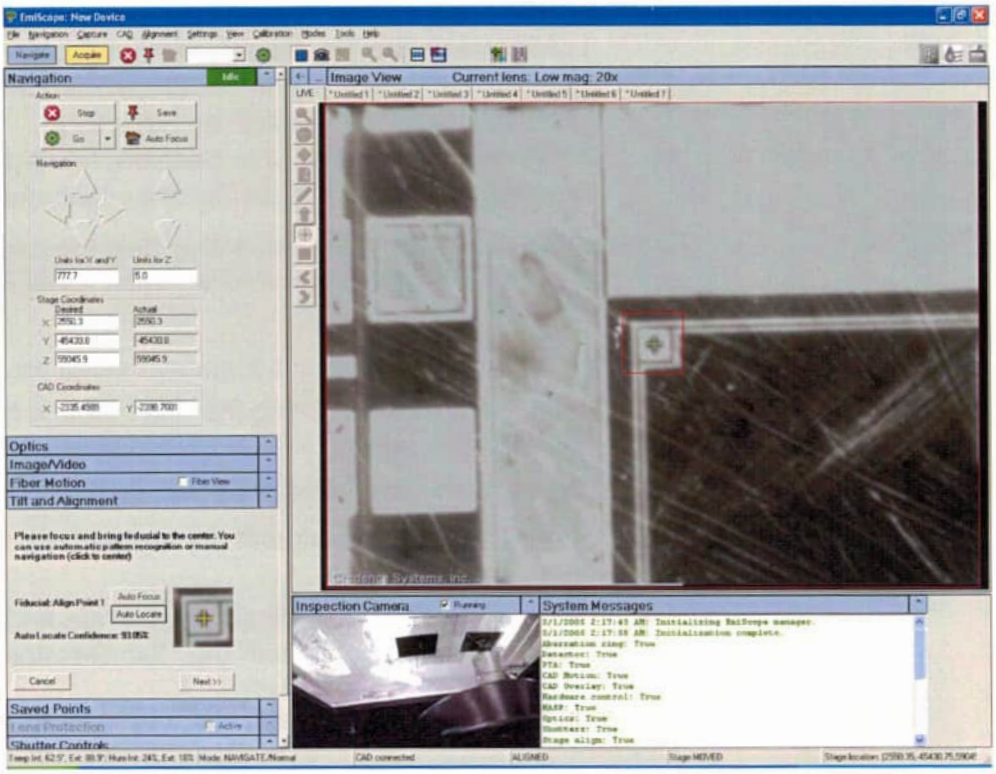
10. Select Next to continue the Table Tilt Wizard. The EmiScope-II will automatically switch from the laser source to the Low magnification objective and return to the XY location before the tilt procedure was initiated, and the Tilt Wizard will update to allow for locating the unique feature identified in step 6. Before feature location, it may be necessary to re-focus the device image. After focus, use the Auto Locate button to automatically relocate the unique feature using pattern recognition. See Figure 57 on page 102.

FIGURE 57. Tilt Wizard Feature Re-location



11. Select Next to continue the Table Tilt Wizard. The EmiScope-II will automatically move the XYZ stages to the first CAD alignment point to begin the rapid 3-point alignment. Use the Auto Locate button to automatically relocate the first CAD alignment point. See Figure 58 on page 103.

FIGURE 58. Tilt Wizard Rapid 3-Point Alignment



12. Select Next to continue the Tilt Wizard and repeat step 11 for the remaining two alignment points.
13. When the rapid 3-point alignment is completed, a panel will appear for confirmation to save the new 3-point alignment. Click Yes, and the Tilt Wizard is complete. The EmiScope-II will automatically move to the previous XY location.
14. Upon completion of the Tilt Wizard, the SIL can be used for imaging and data acquisition.

3-point Alignment Wizard

The 3-point Alignment Wizard is used for performing a rapid, semi-automatic 3-point alignment after an initial 3-point alignment is performed. See

"Three Point CAD Alignment" on page 83. The 3-point Alignment Wizard can be used in two aspects:

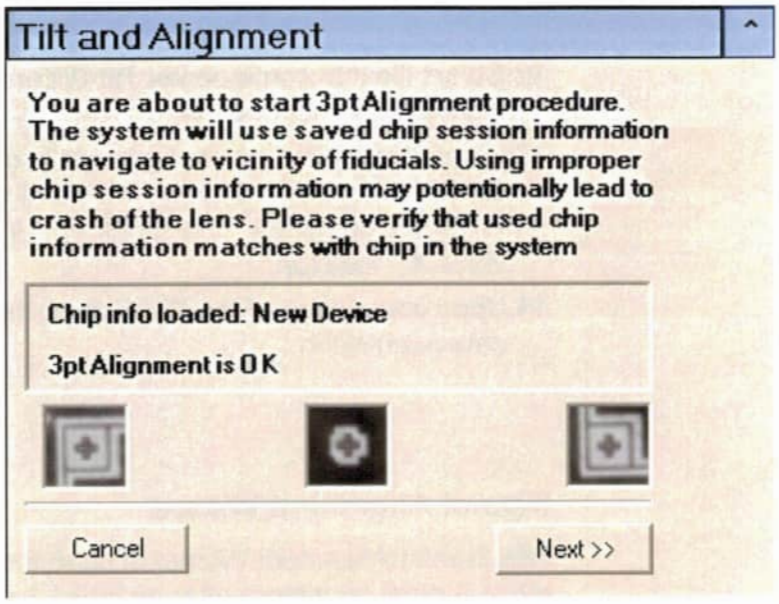
1. After using the Tilt Wizard, the EmiScope-II system will automatically execute the 3-point Alignment Wizard to correct the alignment after a tilt operation. See "Tilt Wizard" on page 97.
2. When using a store Chip Session, the 3-point Alignment Wizard can be used to perform a rapid 3-point alignment.

Note: Use of an improper stored Chip Session can result in system and/or DUT damage. Be sure to use a Chip Session that is correct for the current device under test.

- **To perform a rapid 3-point alignment using the 3-point Alignment Wizard,**

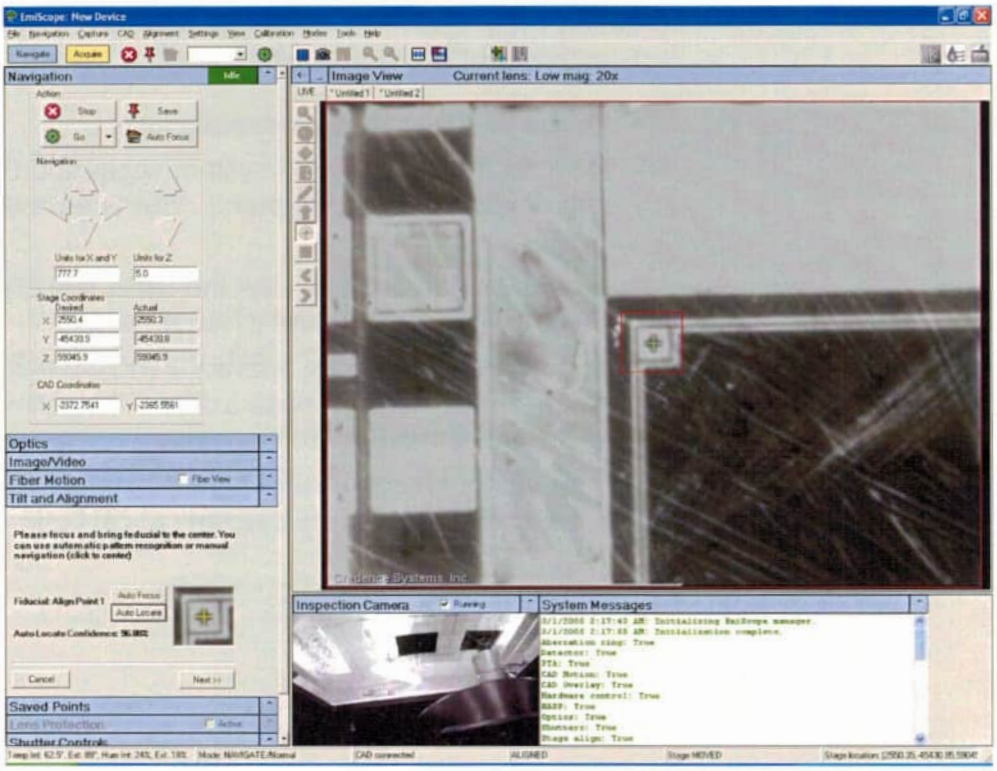
1. Load a Chip Session using the File menu in Navigation mode. See Figure 26 on page 52.
2. In Navigation Mode, use the Low magnification lens to image the DUT.
3. Select the 3-point Alignment Wizard from the Tilt and Alignment control panel.
4. The 3-point Alignment Wizard will update and display images of the alignment points stored with the Chip Session. See Figure 59.

FIGURE 59. 3-point Alignment Wizard Initialization


Tilt and Alignment
You are about to start 3pt Alignment procedure. The system will use saved chip session information to navigate to vicinity of fiducials. Using improper chip session information may potentionally lead to crash of the lens. Please verify that used chip information matches with chip in the system
Chip info loaded: New Device
3pt Alignment is OK
Cancel
Next >>

5. Select Next to continue the 3-point Alignment Wizard, and the EmiScope-II system will automatically move to the vicinity of the first alignment point.
6. Focus the image and using the 3-point Alignment Wizard image display as a reference, select the current location of the first alignment point by either using the Auto Locate button to locate the point automatically using pattern recognition, or select the point on the image using the mouse.

FIGURE 60. 3-point Alignment Wizard First Alignment Point



7. Select Next to continue the 3-point Alignment Wizard. The EmiScope-II system will automatically move to the vicinity of the second alignment point.
8. Repeat step 6 for the second and third alignment points.
9. When the rapid 3-point alignment is completed, a panel will appear for confirmation to save the new 3-point alignment. Click Yes, and the 3-point Alignment Wizard is complete.

10. Upon completion, you can navigate to a point of interest on the DUT using either CAD or stage coordinates.

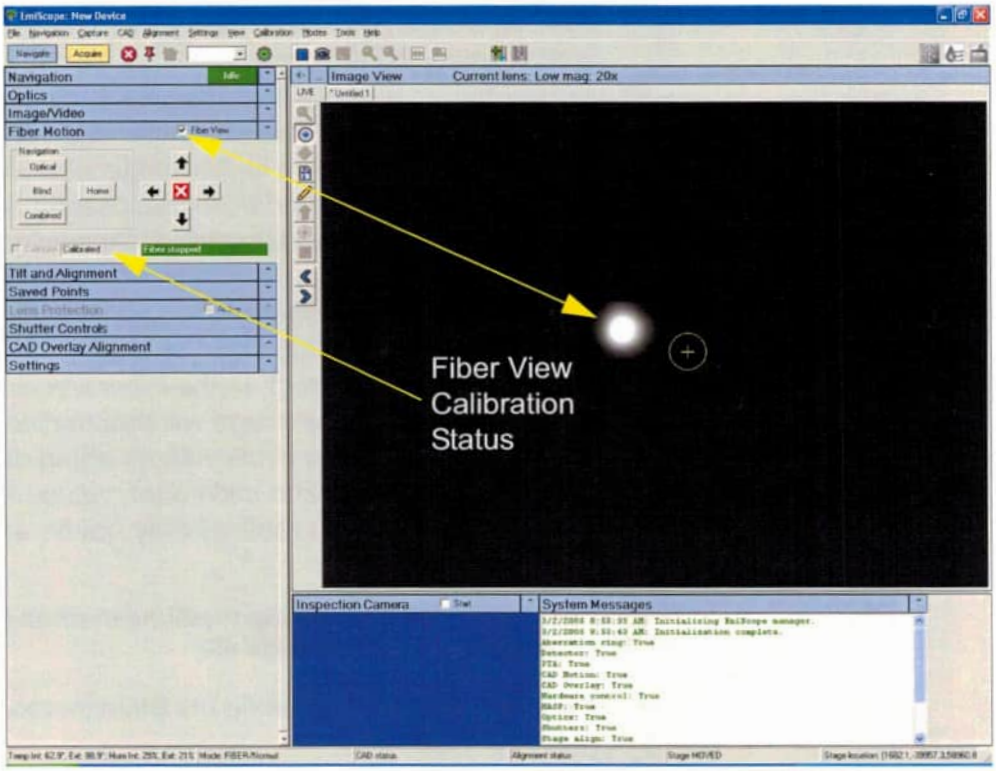
Fiber Motion Control Panel

The Fiber Motion control panel contains controls to select the area of interest for photon collection once the SIL has been landed. The yellow detection circle in the image view area is a software representation of the system optical fiber location for photon collection. You should always use the Fiber Motion control panel to verify that the optical fiber location corresponds to the placement of the software detection circle.

- **To use the Fiber Motion control panel,**

1. Perform the EmiScope-II system setup and SIL landing for a DUT location of interest. See Chapter 3, "Starting Up the EmiScope-II" on page 37.
2. After the SIL is landed, click the Detection Circle shortcut in the Image View Toolbox, see Figure 67 on page 115.
3. In the image view area, move the mouse pointer to the location of interest and click the left mouse button. The yellow detection circle will move to the location selected.
4. In the Fiber Motion control panel, click the Fiber View check box to enable the image of the system optical fiber in the image view area.

FIGURE 61. Fiber Motion Control Panel and Fiber View



5. The initial location of the Fiber View must be calibrated. The calibration is automated by the system and is a one-time operation unless the EmiScope-II system is powered down. The calibration status at the bottom of the Fiber Motion control panel will indicate proper calibration of the Fiber View with the message: "Calibrated". See Figure 61. If the message "Not Calibrated" is displayed, the Fiber View must be calibrated by selecting the Home button in the Fiber Motion control panel before using fiber motion controls. The Home command may take several minutes to complete.
6. The Fiber Motion control panel has three methods for locating the Fiber View within the position of the software detection circle.

   The Arrow keys in the Fiber Motion control panel can be used to manually move the fiber image to the detection circle location. With Fiber View selected, use the Arrow keys to locate the fiber image within the software detection circle.

The Optical method of fiber motion is recommended and can only be used when the Fiber View checkbox is selected which makes the fiber image visible in the image view area. With Fiber View selected, click the Optical button and the fiber image will automatically move to the location of the software detection circle. You can then deselect the Fiber View checkbox to return to the image view. At this point photon data collection can be performed from the location of interest by switching to Acquisition mode. See Chapter 7, "Acquisition Mode" on page 121.

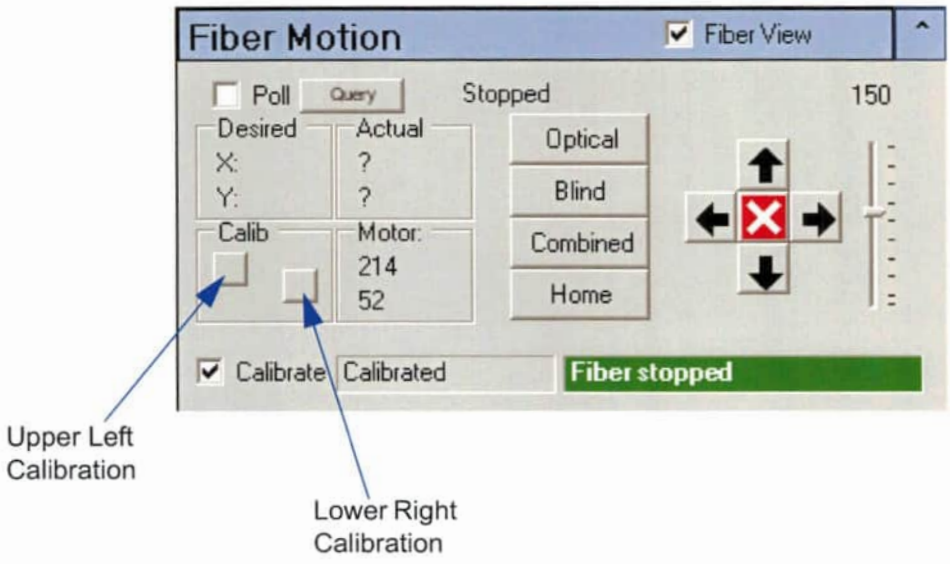
The Blind method of fiber motion can be used without enabling the Fiber View. In the image view area, place the software detection circle at the location of interest. In the Fiber Motion control panel, click the Blind button, The fiber image will automatically move to the location of the software detection circle without being displayed. The blind method relies on the fiber motion calibration values to place the fiber image at the area desired. This method may not be as accurate as using the Optical method.

Note: Fiber calibration for using the Blind method is a Superuser function. See "Superuser Functions" on page 49.

- **To calibrate the fiber for using the Blind method,**

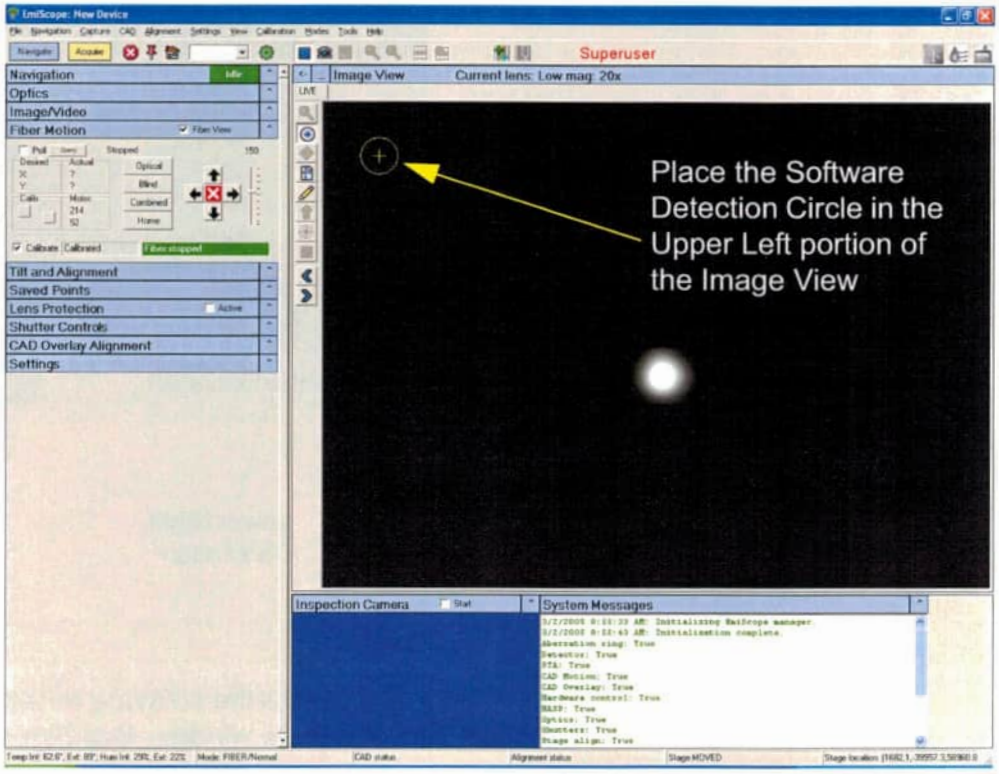
1. Logon as Superuser.
2. Enable the fiber image by selecting the Fiber View checkbox in the Fiber Motion control panel.
3. Select the Calibrate checkbox in the Fiber Motion control panel, and the panel will update to show the fiber motion calibration. See Figure 62 on page 109.

FIGURE 62. Fiber Motion Calibration



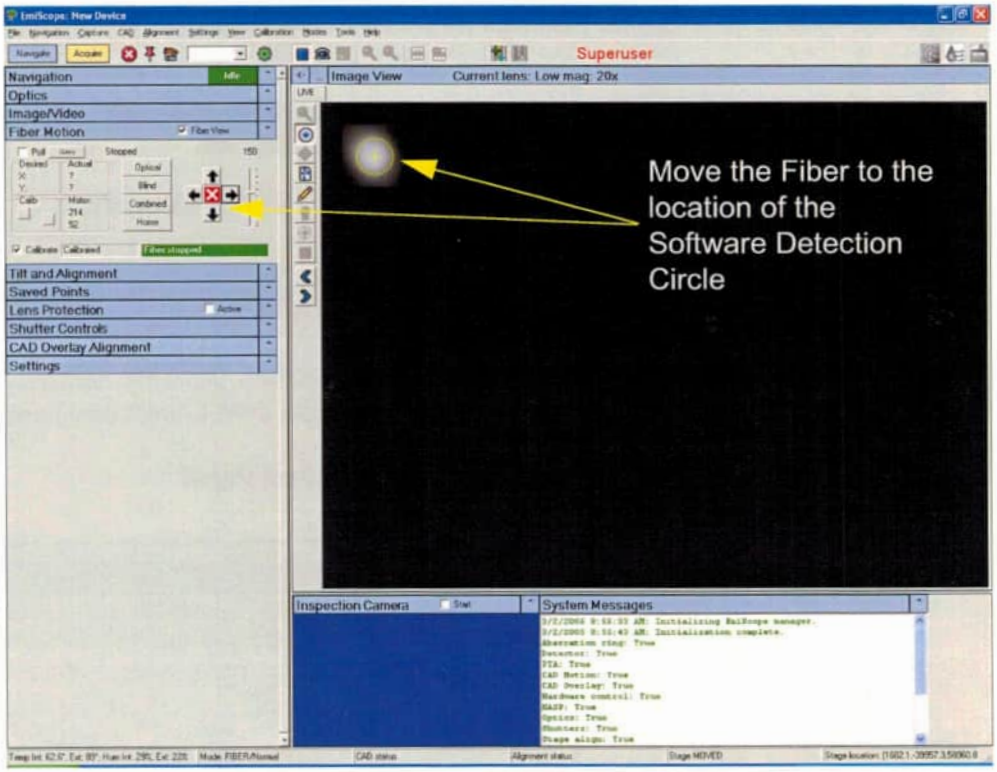
4. In the image view, move the software detection circle to the upper left region of the image view window. See Figure 63 on page 110.

FIGURE 63. Fiber Motion Calibration, Upper Left, Place Detection Circle



5. Use the Arrow keys in the Fiber Motion control panel to manually move the fiber image to the software detection circle. See Figure 64 on page 111.

FIGURE 64. Fiber Motion Calibration, Upper Left, Move Fiber



6. After moving the fiber to the detection circle, click the Upper Left Calibration button in the Fiber Motion calibration panel. See Figure 62 on page 109.
7. Repeat the procedure for the Lower Right portion of the image view area.
8. Upon completion of the calibration, use the Blind method of fiber positioning and verify that the fiber moves to the location of the software detection circle. If the fiber placement is incorrect, the calibration procedure can be repeated.
9. When the calibration is completed, deselect the Calibrate check box in the Fiber Motion control panel.

Settings

The Settings panel allows you to set the Automatic Drift Correction parameters. For more information on Automatic Drift Correction, see page 77.

Note: Changing parameters in the Settings panel is a Superuser function. See "Superuser Functions" on page 49.

- **To change the Settings for drift correction**

1. Logon as a Superuser
2. In the Settings panel you can change the relative settings for Automatic Drift Correction.
3. Upon finishing the selection, click the Apply button. The new settings will be used when Automatic Drift Correction is enabled.

FIGURE 65. Settings Control Panel

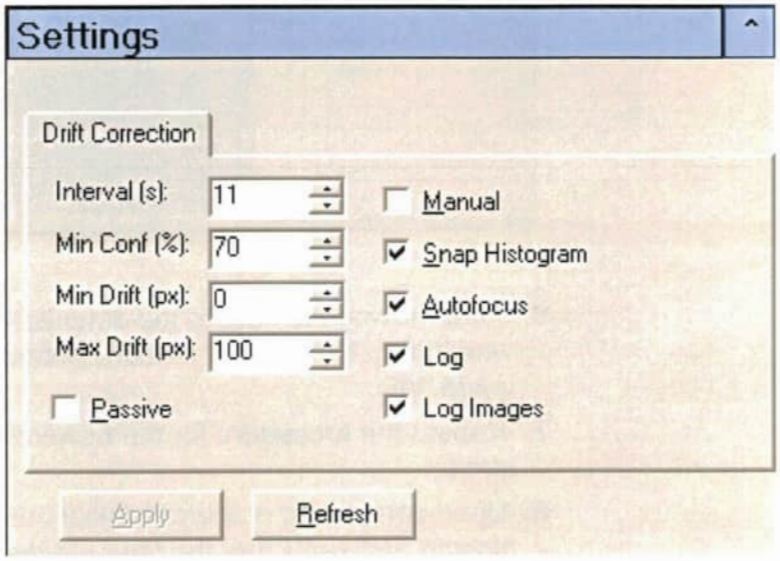


TABLE 13. Drift Correction Settings

Interval	The interval in seconds for the system to perform drift correction
Min. Conf (%)	The confidence level of pattern recognition

TABLE 13. Drift Correction Settings

Min. Drift	Minimum pixels of image movement under which it is considered no drift
Max. Drift	Maximum pixels of image movement that the software can correct
Manual	When checked, perform the drift correction manually
Snap Histogram	When checked, take a snap shot of the histogram prior to performing drift correction
Autofocus	When checked, autofocus is activated for drift correction
Log	When checked, drift correction events will be logged
Log Image	When checked, drift correction images will be saved
Passive	When checked, the drift correction will be recorded, but no drift correction will be performed

Using the Inspection Camera Window

The EmiScope-II uses two types of cameras: an inspection camera and a microscope camera. The inspection camera is a small black/white video camera used to give the user a view of the DUT and microscope lenses. The microscope camera is IR sensitive and is used to view the DUT at different magnifications for alignment and navigation. The image display area is used only for the microscope camera view.

- **To view the inspection camera video image,**

1. Click the Start check box in the Inspection Camera heading. When the Inspection Camera is operating, the Start check box will display Running, and the camera image will be displayed.
2. The Inspection Camera is automatically disabled in Acquisition mode.

FIGURE 66. **Inspection Camera Window**

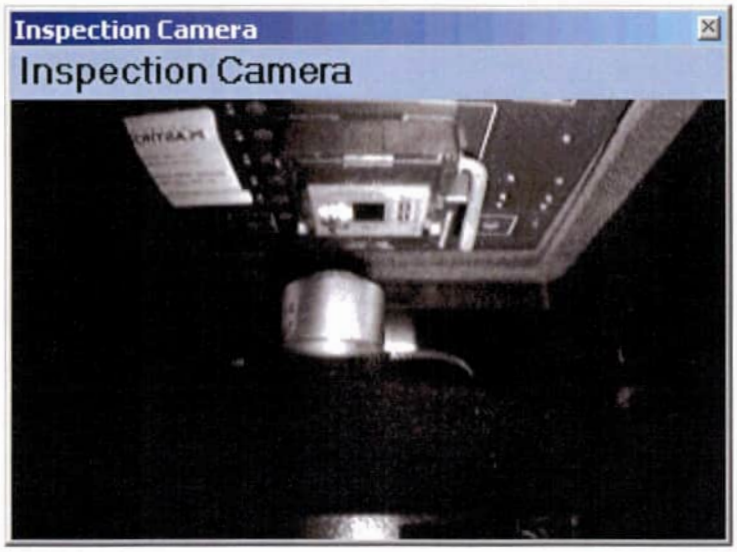
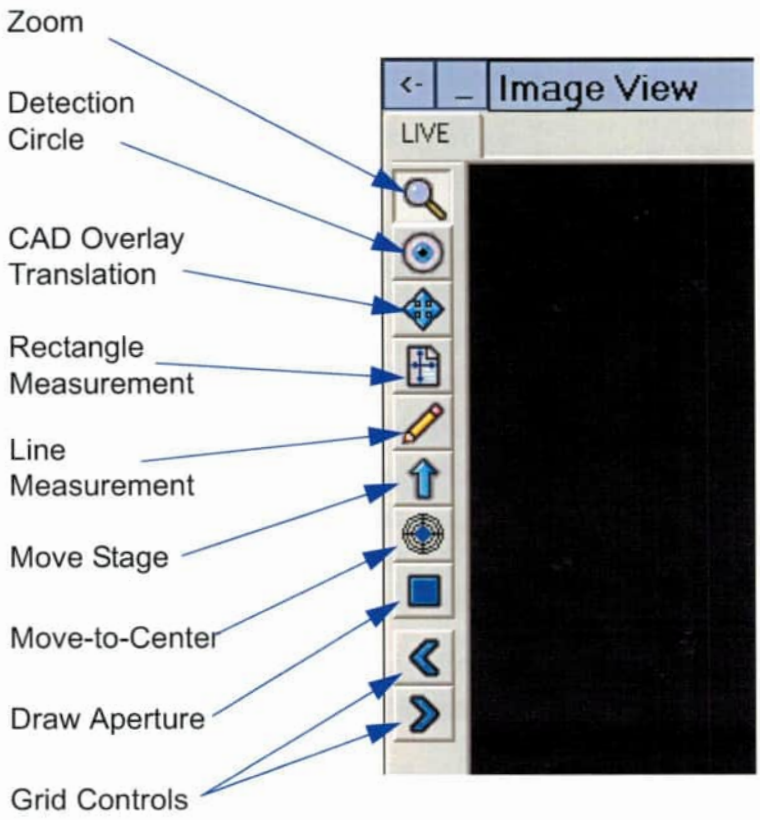


Image View Toolbox

The toolbox controls provide various controls for use in the image view area.

FIGURE 67. **Image View Toolbox**



Zoom. You can use the mouse to zoom into a selected area. In zoom mode, the mouse allows you to select portions of the image you wish to expand on the screen by clicking, then dragging a rectangle over the desired location. The image ratio of the selection is maintained and the resulting image will be determined by the smallest coordinate change. The zoom is limited to 30 x 30 pixels.

Detection Circle. This shortcut has two functions. Under normal EmiScope-II usage, selecting the Detection Circle shortcut allows placement of the software detection area at the location desired in the image view area. See "Fiber Motion Control Panel" on page 106.

The Detection Circle shortcut is also used to define the sized of the yellow software detection area by drawing a circle within the image view area

Note: Defining the Detection Circle requires Superuser and Credence Support access. See "Superuser Functions" on page 49 and "Credence Support Functions" on page 51.

- **To define the detection circle,**

1. Select Fiber view from the Fiber Motion control panel.
2. The image of the fiber should appear in the image view area when using the high magnification lens and the lens is focused on the DUT. See Figure 61 on page 107. The detection circle should be drawn over the image of the fiber.
3. Logon as Superuser and as Credence Support.
4. Click on the Detection Circle shortcut in the image view toolbox.
5. Click and hold the mouse at the edge of the fiber image.
6. Drag and release at the opposite side of the fiber image.
7. Click on the Settings menu, then the Save Detection Circle command and save the Detection Circle to memory.

CAD Overlay Translation. Selecting this function allows interactive X and Y translation of the CAD Overlay relative to the live DUT image.

Rectangle and Line Measurement. You can use the mouse to calculate physical distances on the image. Rectangle Measurement is used for dimensional display of a mouse drawn box on the image, and Line Measurement is used for dimensional display of a single mouse drawn line.

Move Stage. When Move Stage is selected, clicking in the image view area moves the stage in the direction of the cursor location by the increment displayed in the Navigation control panel.

Move-to-Center. When Move-to-Center is selected, clicking in the image view area moves the stages to center the clicked location.

Draw Aperture. When Draw Aperture is selected, click and drag to draw a box in the image view area. The four system shutters are then automatically placed to fit the drawn box.

Note: Do not use Draw Aperture unless the shutters have been calibrated. See "Shutter Controls Control Panel" on page 91.

Grid Controls. Use the Grid Controls to display a grid of equally spaced lines on the image view area. The right grid control arrow, >, increases the number of grid lines, and the left grid control arrow, <, decreases the number of grid lines.

Status Bar and System Messages

The Status Bar at the bottom of the Navigation mode window has five active fields. The first field displays system mode and turret change events. The second field display CAD connection information. The third field indicates the state of the 3-point alignment. The fourth field displays stage change events, and the fifth field displays the stage coordinates of the current position. Additional system status items are displayed in the System Messages panel.

Hard Dock Mode

Hard Dock mode is used only when the EmiScope-II is directly docked to any Automatic Test Equipment, without any cable interface. The use of Hard Dock mode changes the operation of the table top tilt/tip functionality. When in Hard Dock mode, the table top interface is held rigidly in place by the docked test head, and when the using the tilt/tip for SIL operations, the EmiScope-II table top will be adjusted relative to the table top interface. The user operation of tilt/tip is not affected.

- **To use Hard Dock mode,**

1. Directly dock the EmiScope-II to an ATE system. Direct docking the EmiScope-II may require special fixturing.
2. Select Hard Dock from the Mode menu in Navigation mode.

3. When Hard Dock is selected, it is important to disable air flow to the optical table by closing the Table Level switch on the EmiScope-II pneumatic panel.
4. While in Hard Dock mode, use the EmiScope-II software operations as documented.
5. When undocking the EmiScope-II, remove the docked ATE, disable Hard Dock from the Mode menu in Navigation mode, and open the Table Level switch on the EmiScope-II pneumatic panel.

FIGURE 68. EmiScope-II Pneumatic Panel, Table Level Control Location

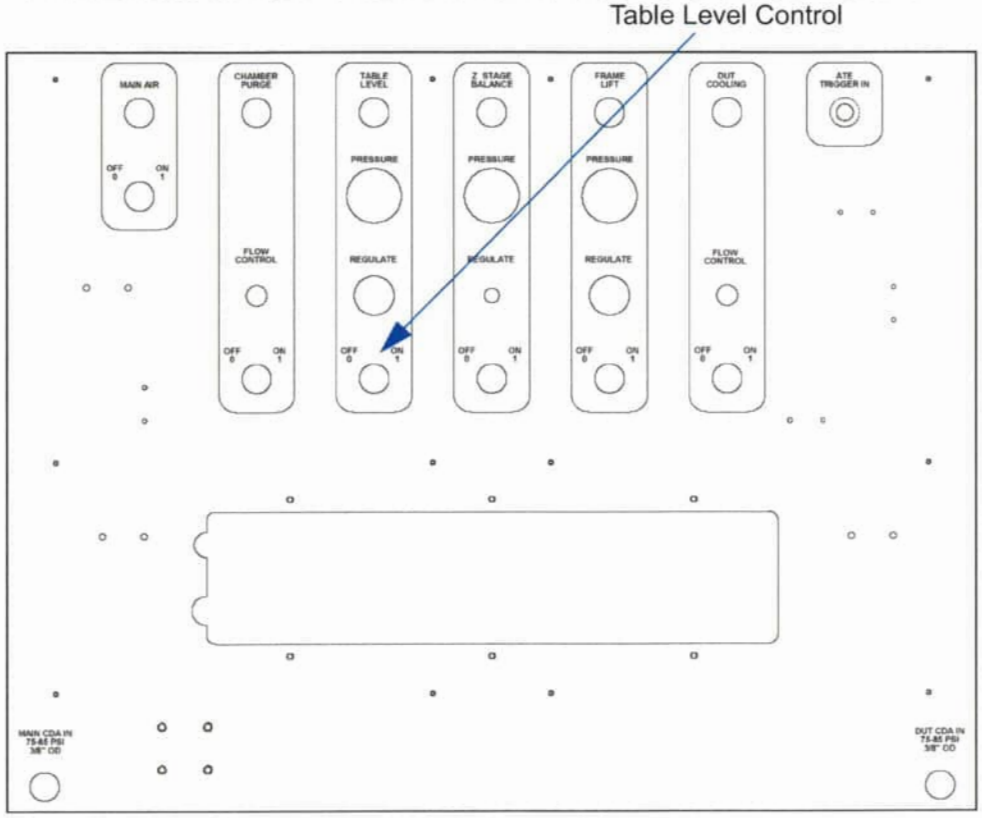
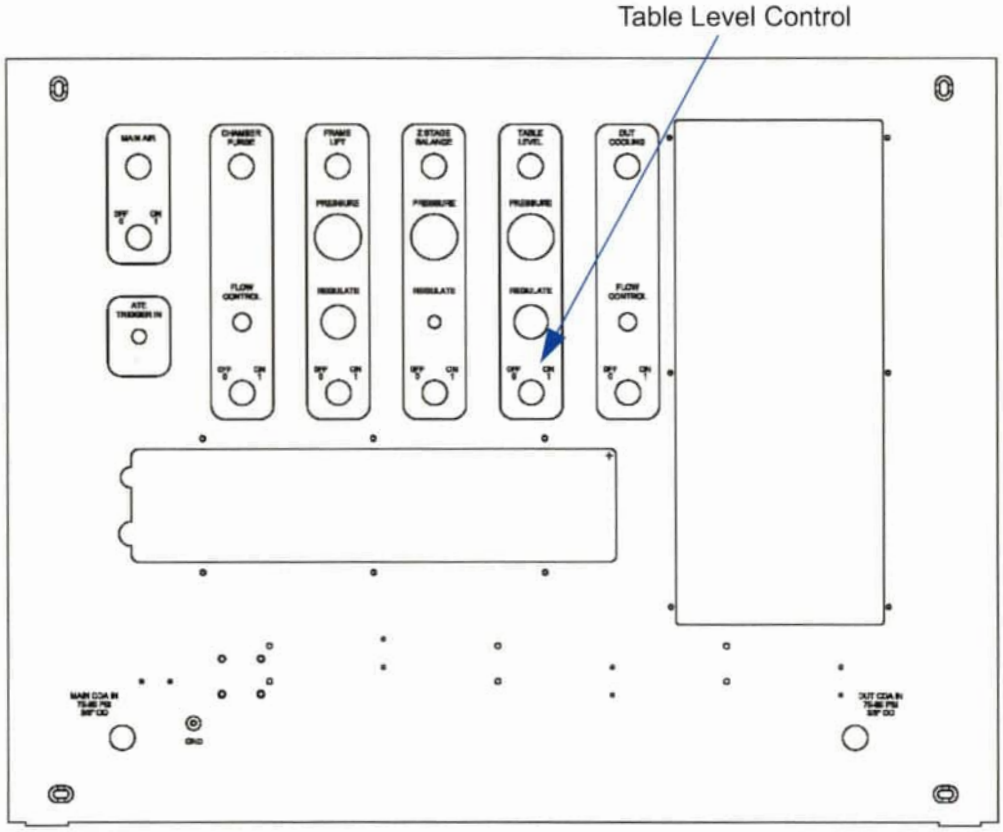


FIGURE 69. EmiScope-II*t* Pneumatic Panel, Table Level Control Location



CHAPTER 7

Acquisition Mode

Acquisition mode in the EmiScope-II software application is used for photon data acquisition and analysis. Acquisition mode is used to set up the EmiScope-II photon detector and electronics, collect and recall data, save data to disk, and save a collection of optical waveforms (histograms) into standard file formats. It provides features to filter and periodically average optical waveforms. It can also be used to calculate detection levels, peak widths, peak centers, and peak heights.

The Acquisition mode optical waveform data consists of histograms of events, binned in time. For more information on the histogram data refer to "Process Overview" on page 37. The histogram event data also consists of the corresponding readout of the electronic parameters such as the detector offset and span. These parameters are detailed in Chapter 5, "Detector". Acquisition mode is selected from the EmiScope-II software application. To launch the EmiScope-II software, see "Launching the EmiScope-II Software" on page 46.

This chapter describes how to start and use Acquisition mode. It describes:

- the software layout and controls features
- procedures for acquiring data
- how to improve the signal-to-noise ratio of a histogram

- saving and displaying histograms

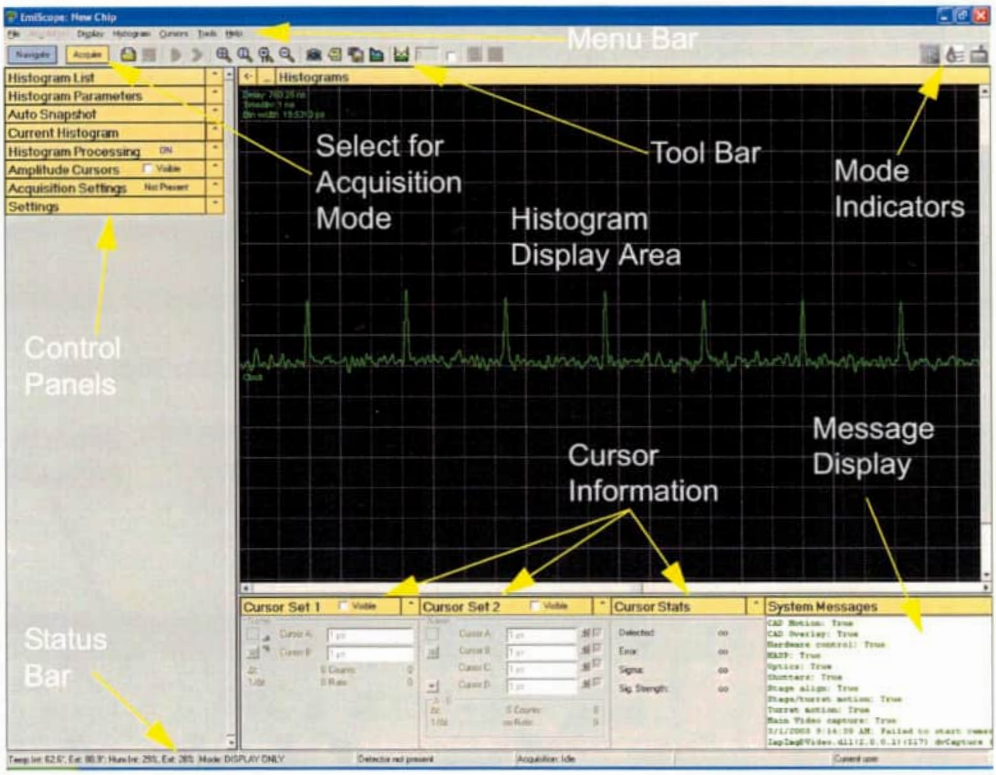
Many of the buttons or text boxes display their function after the cursor rests over the area of interest for a few seconds.

Acquisition Mode GUI

The Acquisition mode GUI is divided into eight functional areas,

- menu bar
- main tool bar
- mode indicators
- histogram display area
- cursor information
- control panels
- status bar
- message display

FIGURE 70. Acquisition Mode



The Acquisition mode menu bar consists of menus for starting and stopping photon data collection, saving, loading and viewing histograms, and changing settings. Certain menu commands have shortcuts in the main tool bar.

TABLE 14. Acquisition Mode Menu Commands

Menu	
File	To open, close and save histogram files; and to terminate or exit the software application.
Acquisition	Start/stop/resume data collection, and snapshot controls.
Display	Controls the histogram display region - grid, zoom, and display description features.
Histogram	Functions for locating histograms, assigning a description, renaming histograms, changing their color, fitting a Gaussian profile to a peak, and showing the last Gaussian fit parameters.

TABLE 14. Acquisition Mode Menu Commands (Continued)

Menu	
Cursors	To control the visibility, centering, and color of the two sets of cursors. The cursors are used to measure timing between events and also to mark detection and fit calculations.
Tools	Enable/disable control panels display.
Help	For the software version number and contact information.

The main tool bar contains shortcuts for certain menu commands.

FIGURE 71. Acquisition Mode Main Tool Bar

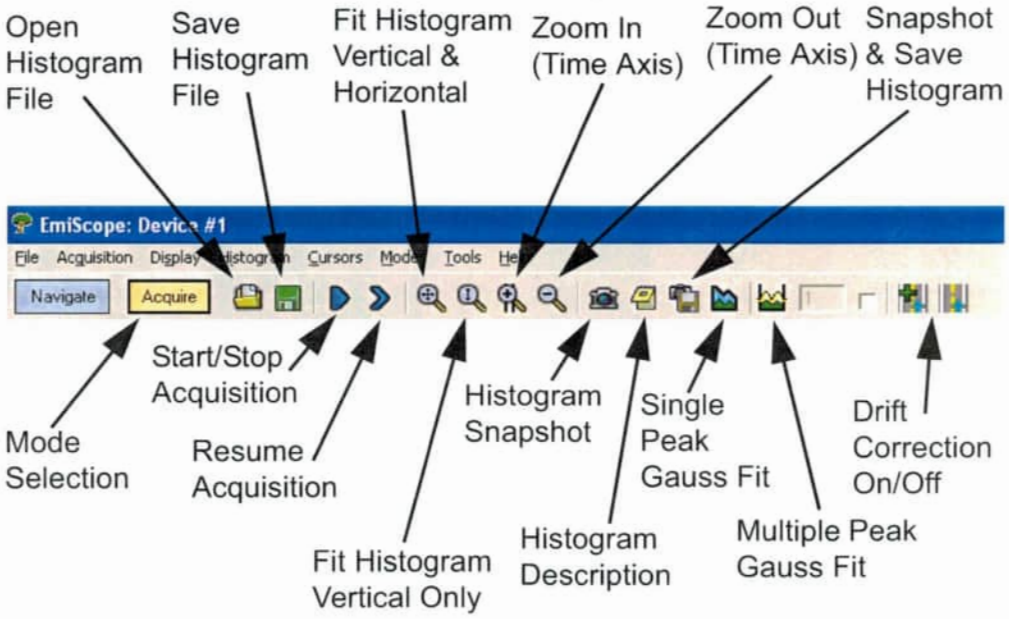


TABLE 15. Acquisition Mode Main Tool Bar Commands

Mode Selection	Selects Navigation or Acquisition modes.
Open Histogram File	Opens a histogram data file from disk.
Save Histogram File	Saves selected histogram data to disk.
Start/Stop Acquisition	Toggle to Start/Stop Live histogram acquisition. Resets Live histogram data.

TABLE 15. Acquisition Mode Main Tool Bar Commands

Resume Acquisition	Resumes acquisition of Live histogram. Does not reset Live histogram data.
Fit Histogram Vertical & Horizontal	For a selected histogram, the histogram display area will scale vertically and horizontally to view the entire histogram data acquisition.
Fit Histogram Vertical Only	For a selected histogram, the histogram display area will scale vertically only to view the entire histogram data acquisition
Zoom in	For histogram display area, zoom in on the horizontal axis (decrease time/div).
Zoom Out	For histogram display area, zoom out on the horizontal axis (increase time/div).
Snapshot	Stores the current state of the Live histogram to an identical copy and provides a default name to the copy.
Histogram Description	Set/Display user defined descriptive information for a selected histogram.
Snapshot & Save Histogram with Description	Snapshots Live histogram, saves to disk with user defined description
Gauss Fit	Applies Gaussian fit function to histogram peak bounded by the main time cursors.
Multiple Peak Fit	Applies Gaussian fit function to histogram peaks bounded by the main time cursors. Optional software.
Drift Correction On/Off	Apples Drift Correction during acquisition to correct the DUT drift

The histograms are plotted in the histogram display area, which is designed to operate similar to an oscilloscope screen. The horizontal dimension represents time and the vertical dimension represents photon count. The Live histogram is updated during an acquisition approximately once per second. You can use the horizontal and vertical scroll bars to pan in the respective directions. Furthermore, you can click on and drag histograms to change their placement on the histogram display area.

Acquisition Mode Control Panels

The control panels for Acquisition mode are used for histogram display management, viewing histogram parameters, defining automatic histogram acquisition parameters, processing histogram data, using amplitude cursors, and adjusting the detector and electronics controls for photon data collection. Control panels can be opened, closed, and floated on top of the EmiScope-II software application. Clicking on closed control panel heading will open the control panel in its current location. Clicking on an open control panel heading will close the panel. Clicking on a control panel carat, ^, will float the panel on top of the software application. Floating panels can be placed anywhere on the desktop. To close a floating panel, click the panel's X icon.

Histogram List Control Panel

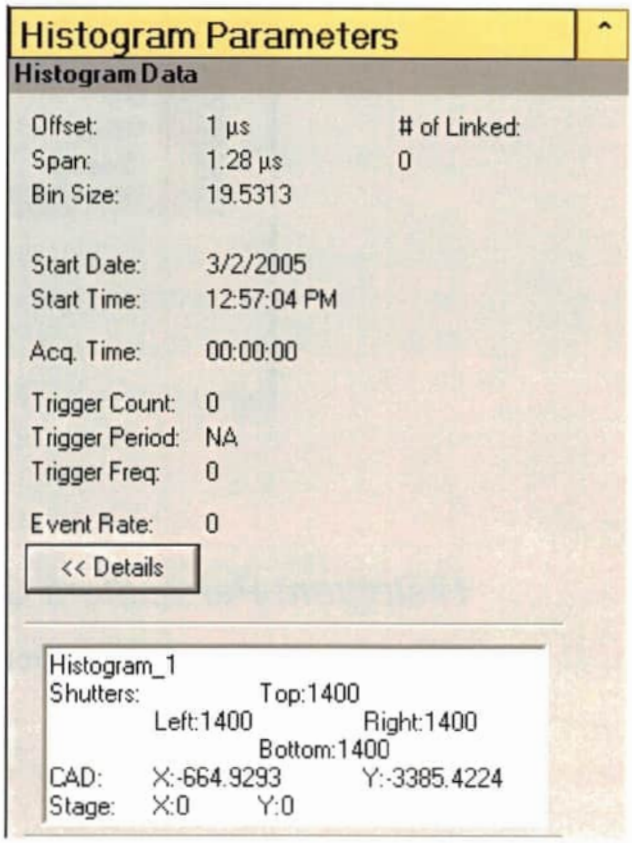
The Histogram List control panel is a list of all the histograms currently stored in memory and is used to manage, select, and delete histograms. The first histogram is always titled "Live" and represents the photon collection data being acquired or just acquired. The histogram list grows as histograms are acquired and saved. Each histogram is assigned a name along with a color to provide a label for the histogram in the display area. You can select any histogram in the list and make it visible or invisible by using the check box. The current histogram selected is highlighted in the histogram list.

FIGURE 72. Histogram List Control Panel

Histogram Parameters Control Panel

The Histogram Parameters control panel displays relevant information for a selected histogram.

FIGURE 73. Histogram Parameters Control Panel



For each histogram that is stored, the following information is saved with the histogram;

- Offset — pTA offset value
- Span — pTA span value
- Bin Size — pTA bin size (span / 65536)
- Start Date — date of histogram acquisition start
- Start Time — time of histogram acquisition start
- Acq. Time — total time of histogram acquisition
- Trigger Count — number of trigger events(test loops) that occurred from start of histogram acquisition
- Trigger Period — test loop length

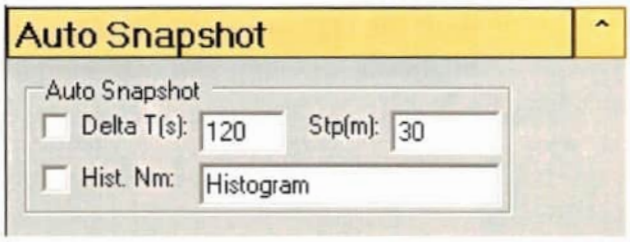
- Trigger Freq. test loop frequency [1 / (trigger period)]
- Event Rate number of photon events detected per second over the entire histogram acquisition.
- Details displays histogram name, shutter positions, stage and CAD coordinates for when the histogram was stored

The information in the Histogram Parameters control panel display is for the currently selected histogram.

Auto Snapshot Control Panel

In Acquisition mode, you can automate the photon data acquisition process. You can set up the acquisition process to automatically store the histograms, set the length of the acquisition, save and name the stored histograms files.

FIGURE 74. Auto Snapshot Control Panel



♦ **To automate photon data acquisition,**

1. Select the Auto Snapshot control panel.
2. Click on the Hist. Nm.(Histogram Name) check box to activate the auto snapshot function. Histogram Name is the name that is used when the file is saved. The file is saved to the default folder which is the last folder used to load or save a file. You can insert the snapshot time and/or date in the Histogram Name field by typing **&T** and/or **&D** respectively. The format of the time and date stamps are hhmmss and mm-dd-yy.

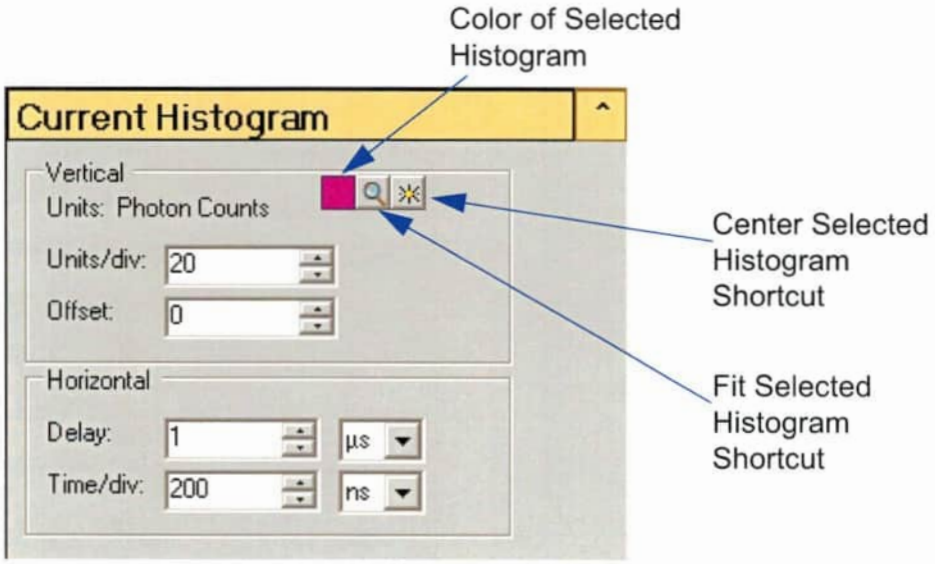
3. Click in the DeltaT(s) text box and type the interval time in seconds between snapshots. If an invalid entry is typed (you cannot enter 0), the last valid entry is used.
4. Click in the Stp(m) text box and type the total acquisition time in minutes. The Live acquisition will be stopped after the time entered. If an invalid entry is typed (you cannot enter 0), the last valid entry is used.

Below the histogram list are the Acquisition, Display, and Cursors tabs (see Figure 72). The Acquisition tab contains the acquisition data for a selected histogram, and settings for automatic acquisition.

Current Histogram Control Panel

The Current Histogram control panel lets you change the horizontal offset and scale for the histogram display area. You can use the controls under the Display menu as well to set the delay and time/division. When multiple histograms are displayed, you can click on a histogram to select it, and use the Current Histogram control panel to change the vertical scale and offset of the selected histogram. The colored box corresponds to the color of the selected histogram. The Current Histogram control panel also contains shortcuts for fitting and centering the selected histogram.

FIGURE 75. Current Histogram Control Panel



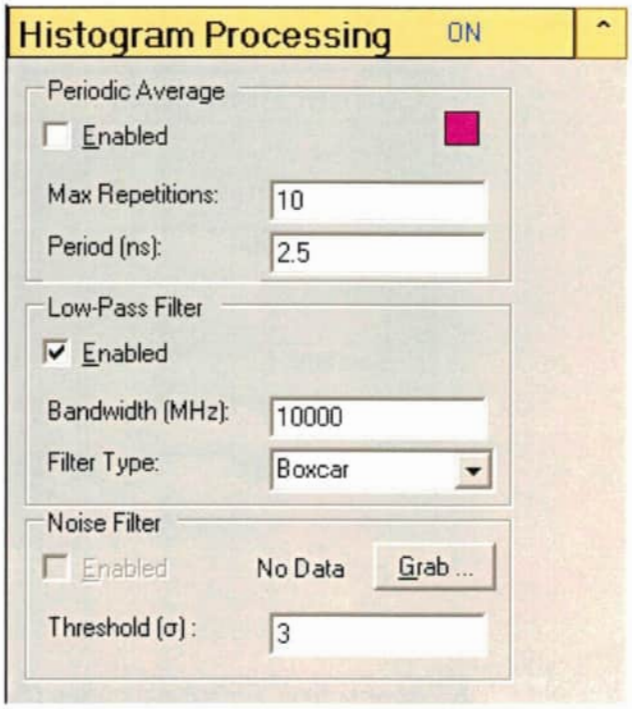
Histogram Processing Control Panel

You can configure the signal processing options to improve the signal-to-noise ratio of a selected histogram. Three algorithms are provided which can be utilized individually or simultaneously:

- Periodic Average
- Low-Pass Filter
- Background Filter

The colored box in the control panel corresponds to the color of the selected histogram.

FIGURE 76. **Histogram Processing Control Panel**



Periodic Average

The Periodic Average filter is useful when the histogram contains a periodic signal of a known frequency. When the entire histogram contains many periods of such signal, it is possible to enhance the signal-to-noise ratio of a few successive periods by splitting the histogram into several segments and averaging the corresponding samples of those segments. The length of the segments is such as to include the desired number of periods, and each segment is chosen to start at the same relative sample in the next available period of the histogram. The actual number of segments averaged depends on the current delay of the displayed histogram. The largest number of segments is achieved when the delay is zero.

The advantage of this filter, compared to the Low-Pass filter, is that it does not smear the edges of the signal pulses, and preserves their width. The disadvantage of this type of filter is that it requires the signal to be of a known period, and is effective mostly when the histogram contains a large number of periods.

♦ **To apply the Periodic Average filter on a selected histogram,**

1. Select the Histogram Processing control panel.
2. Click on the Enabled check box to apply the periodic average filter (see Figure 76).
3. Click in the Max Repetitions field and type the maximum number of histogram segments that should be averaged to obtain the resultant histogram. The length of the segments is automatically calculated to be the smallest number of periods that completely fill the current time span in histogram display. The algorithm averages as many histogram segments as specified by the Max Repetitions parameter. It may average fewer segments if the entire histogram is not long enough to provide the required number of segments.
4. Click in the Period field and type a value for the expected period of the signal in the histogram. This is an essential parameter for the algorithm to produce any significant improvement. You should measure the exact frequency of the periodic signal using the time cursors and use this value for the Period field.

Low-Pass Filter

A Low-Pass filter can be used to smooth the histogram by attenuating its high-frequency components. This is an effective way of improving the signal-to-noise ratio when the noise consists mostly of high frequency components and the signal consists mostly of low frequency components.

The disadvantage of this type of filter is that it also attenuates the high frequency components of the signal itself, thus smearing out its rising and falling edges and causing any histogram peaks to appear wider than they really are. The advantage of this filter, compared to the Periodic Average filter is that it does not require the signal to be periodic.

♦ **To apply the Low Pass filter on a selected histogram,**

1. Select the Histogram Processing control panel.
2. Click on the Enabled check box to apply the Low Pass filter (see Figure 76). The Low-Pass filter can be enabled independently of the Periodic Average filter.
3. Click in the Bandwidth field and type in the amount of attenuation to apply to the high frequencies of the selected waveform.
4. Select the Low Pass filter type from the pull down. Then click Apply.

A large bandwidth value attenuates fewer frequency components than a small bandwidth value. A Bandwidth value of 0 is invalid, as it would suppress all frequencies in the histogram. A Bandwidth value greater than or equal to half of the sampling frequency is equivalent to using no filter. In general, this parameter should be less than half of the sampling frequency, and greater than or equal to the highest significant frequency component in the signal. The sampling frequency is equal to the reciprocal of the Bin Size value shown in the Histogram Parameters control panel for the selected histogram. For example, if the Bin Size is 19.53125ps, then the sampling frequency is 51GHz. Therefore the Bandwidth should be less than about 25GHz for the filter to be effective.

The highest significant signal frequency depends on the signal itself. You can start by taking the reciprocal of twice the expected width of the signal pulses. For example, if the width of the signal pulses is expected to be 300ps, then the Low-Pass filter bandwidth could be set to 1/(2*300ns) = 1.7GHz. Next you can experiment by varying the Bandwidth value and clicking the Apply button in order to find a good compromise between the resultant noise attenuation and the smearing out of signal pulses.

Low Pass Filter Types

Ideal. The Ideal filter type is implemented as a finite impulse response (FIR) approximation to an ideal low-pass filter. An ideal low-pass filter is one that applies a cut-off frequency by passing all frequencies lower than its bandwidth, and blocking all frequencies higher than its bandwidth. An ideal low-pass filter cannot be realized in practice, but an FIR approximation can produce relatively good results for many applications. The output waveform is obtained by convolving the input waveform with a sampled and truncated version of the impulse response of the ideal low-pass filter. The impulse response of the latter is a sin function ($\sin(x)/x$). The truncated version used for the FIR filter includes the main lobe and two lobes on each side of the main lobe.

Boxcar. For the Boxcar filter type, each sample in the output waveform is obtained by averaging *N* corresponding adjacent samples in the input waveform, where

N = (sampling frequency)/(Bandwidth)

Rebin. The Rebin filter performs an interpolation from one histogram into another histogram with the same integrated count but with modified boundaries.

Noise Filter

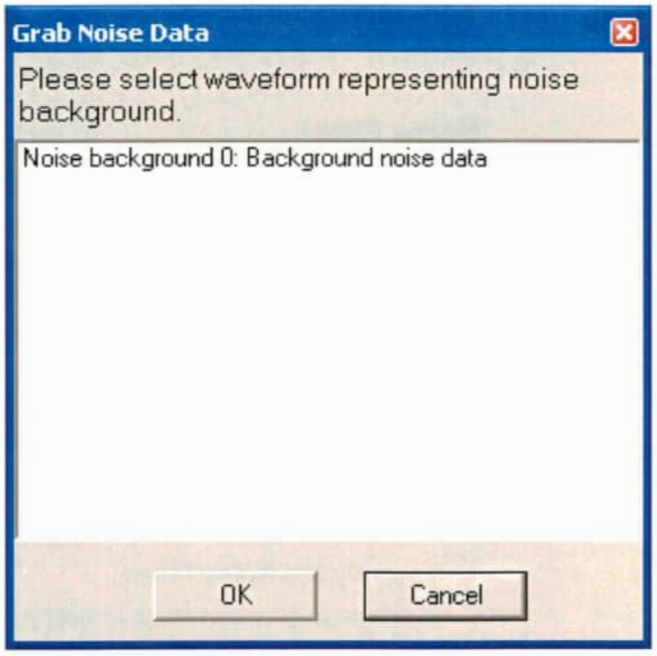
The Noise Filter is optional software, and may not be enabled on all EmiScope-II systems. This function provides users with early identification of histogram peaks by statistical weighting. When background noise is collected, histogram acquisition is performed with the optical bench mirror blocking the optical path to prevent DUT signal photons from being collected.

The background noise is fitted with a least-squared best-fit function, and the signal is enhanced by subtracting the signal histogram from the fitted background data. The random fluctuation of the noise in the background is statistically removed.

- **To apply the Noise Filter**

1. Background noise data is first be collected and used as a reference to apply the background filtering. To perform the background noise measurement, place the main(yellow) time cursors within a time span of interest, and select the Collect Noise Background under the Acquisition mode Histogram menu. The system will collect the noise background within the span defined by the main time cursors.
2. To apply the Noise Filter to either stored histograms or the Live histogram, select the Grab button in the Noise Filter section of the Histogram Processing panel. The Grab Noise Data panel will appear. In this panel, there is a list of all background noise data sets that have been collected. Select a noise background file to be used from the list. See Figure 77.
3. To apply the noise filtering, select Enabled from the Noise Filter section of the Histogram Processing control panel. The noise filter is applied to the selected histogram. The Noise Filter can be applied independent of the Periodic Average and Low-Pass filters.
4. The Threshold(σ) is the statistical certainty filter below which all of the collected signal will be set at zero. It is recommended to set this to a value of 3.

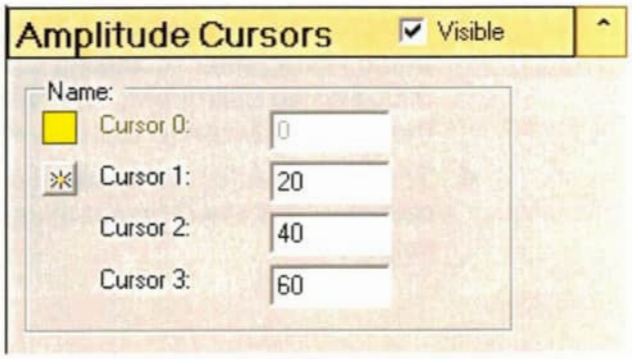
FIGURE 77. **Grab Noise Data**



Amplitude Cursors Control Panel

The Amplitude Cursors are used for making relative vertical scale measurements in the histogram display area.

FIGURE 78. **Amplitude Cursors Control Panel**



The Visible check box enables the cursors in the histogram display area. The color of the cursors can be changed by clicking on the colored box, and a shortcut is available to center the Amplitude Cursors in the histogram display area.

Four Amplitude Cursors are available for use;

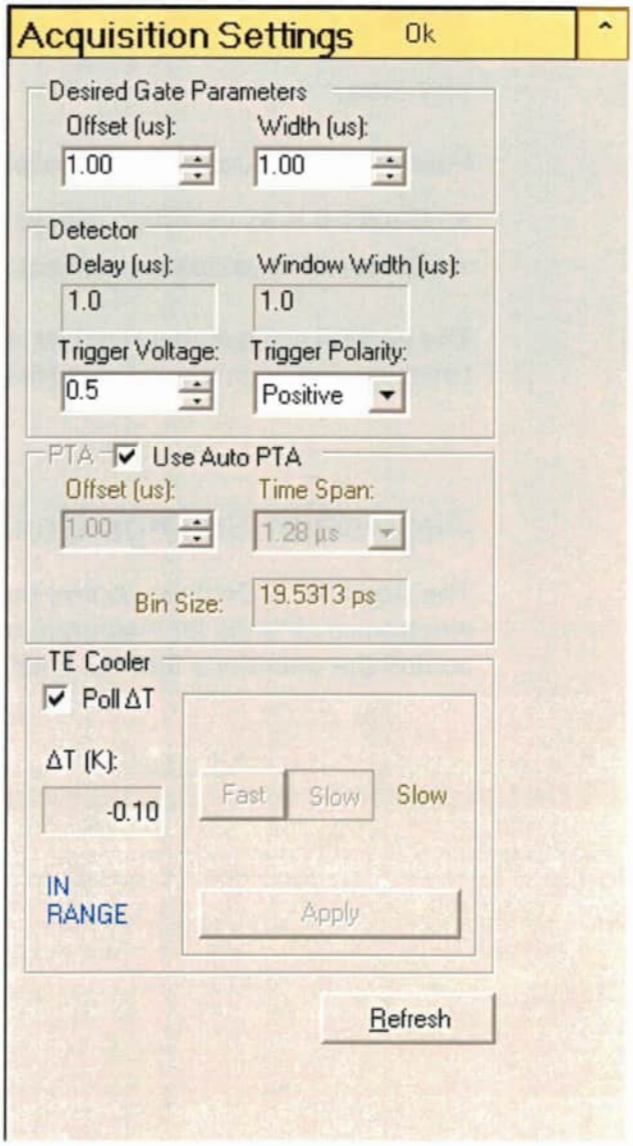
- Cursor 0 is by definition always located at the zero position.
- Cursors 1-3 values are vertical units relative to Cursor 0.

The vertical scale measurements of the amplitude cursors are relative to the Units/div setting in the Current Histogram control panel.

Acquisition Settings Control Panel

The Acquisition Settings control panel is used to define the detector and electronics settings for histogram acquisition, set the detector mode, and control the detector's thermal electric cooler.

FIGURE 79. **Acquisition Settings Control Panel**



The parameters defined in the Acquisition Settings are applied for the Live data acquisition. See "Acquiring a Histogram" on page 142.

Desired Gate Parameters. Defines the Offset from trigger start and the detector window Width for acquisition. Units for the fields are µs.

Detector. Displays the actual Detector Delay and Detector Window Width settings based on the Desired Gate Parameters fields. The Volt field is used to set the input trigger signal threshold value. This value is user defined and should be set to the mid-point of the input trigger signal voltage level. The Polarity field is used to define triggering on the Positive or Negative edge of the input trigger signal.

pTA. Defines the EmiScope-II system electronics settings. pTA values can be set manually or automatically. For manual settings, enter a value in the pTA Offset field which is approximately 80ns less than the Detector Delay, and select a value from the pTA Time Span pull down that is greater than the Detector Window Width. Only discrete values are available for the Time Span. The bin size is automatically calculated as span/65536. For automatic settings, click the Auto pTA check box, and the pTA Offset and pTA Time Span values are automatically entered based on the Desired Gate Parameters fields.

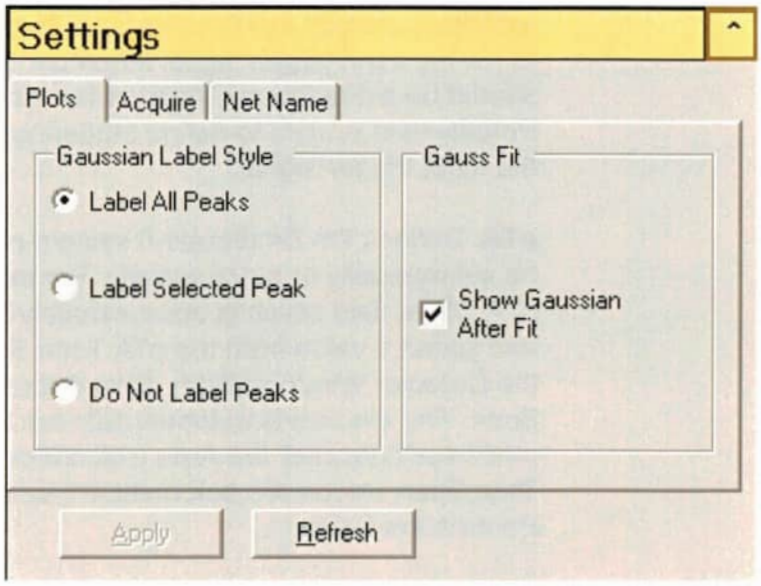
TE Cooler. The Poll ΔT check box enables the display of the detector ΔT monitor. If the detector temperature is out of range, a warning message is displayed. Setting the detector cool down mode, Fast or Slow, is a Superuser function. See "Superuser Functions" on page 49.

Advanced. The Advanced button is hidden and only enabled with Superuser & Credence Support access, and provides fields for defining the default pTA and detector lead time values, and the safe operational range for the TE Cooler ΔT.

Settings Control Panel

The Settings control panel is used to configure the histogram display area, setup the noise filter collection time, and enable automatic histogram naming via FEI Knight's CAD software. See Figure 80.

FIGURE 80. **Settings Control Panel**



Plots. Configures the histogram Gauss fit functions display.

Acquire. Allows you to change the time for collecting noise background for "Noise Filter" on page 135. The default time is 60 seconds, but you can specify a different time.

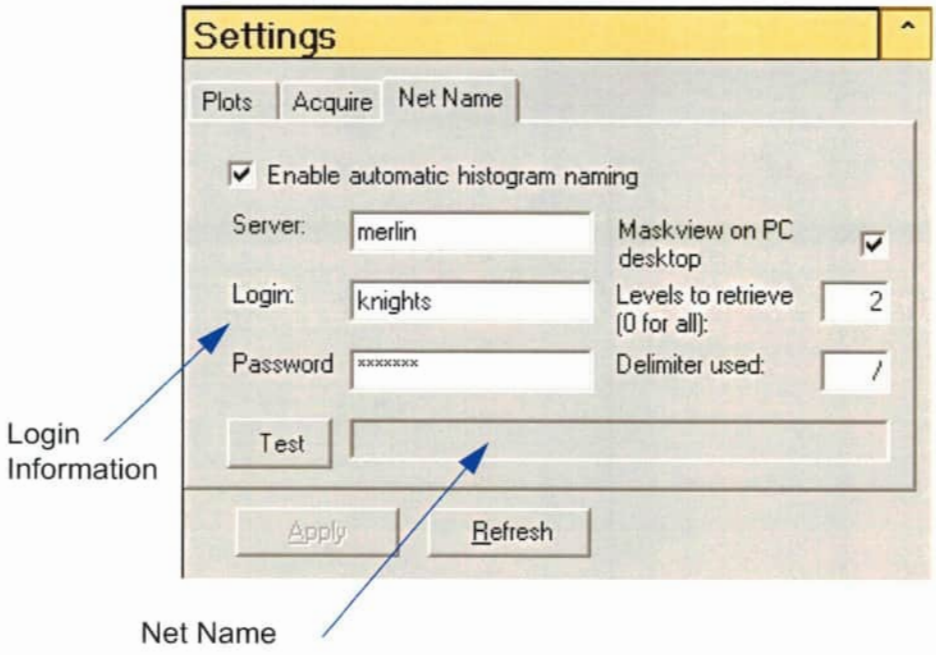
Net Name. Allows you to define automatic histogram naming via FEI Knight's CAD software. To set up the Net Name function, you need to establish the connections between FEI Knight's and EmiScope. In the FEI Knight's environment, a net name can be highlighted in CAD display by selecting a net from Maskview application. With Net Name enabled, when a histogram is stored in Acquisition mode, the histogram name will be automatically named to the corresponding net name selected in the FEI Knight's CAD software.

- **To use Net Name,**

1. You need to connect the FEI Knight's CAD software to the EmiScope software. See "Three Point CAD Alignment" on page 83.
2. In the FEI Knight's Maskview application, make sure that you activate the 'trace signal' function.

3. Select Enable automatic histogram naming in the Net Name panel (Figure 81) and enter the necessary information for login to the workstation running the FEI Knight's software.
4. The Levels to retrieve entry defines the number of net name hierarchical levels to be displayed in the histogram name.
5. The Delimiter used entry defines the FEI Knight's net list hierarchical delimiter, usually a / or a -. If the delimiter is not correctly defined, the Levels to retrieve function will not operate properly.
6. The Test button allows you to test the FEI Knight's/EmiScope connection and net name retrieval. When the Test button is activated, the net name selected in the FEI Knight's Maskview application will appear in the text box if the test is successful.

FIGURE 81. Net Naming Panel



Acquiring a Histogram

This section provides a general description and the procedures for acquiring a histogram. It includes how to set up the detector and electronics timing, and how to start, stop, and pause acquisitions.

Setting Up the Detector and Electronics Timing

The first step in collecting data is determining the timing of the expected signal from the device relative to the trigger signal. Figure 84 shows an example of a typical data acquisition cycle. The top panel shows one complete cycle of the ATE instruction loop,100µs in this example. The beginning of each ATE instruction loop is identified by a trigger signal delivered by the ATE test head to the EmiScope-II timing electronics by the 50Ω coaxial cable.

FIGURE 82. EmiScope-II Trigger Input on Pneumatic Panel

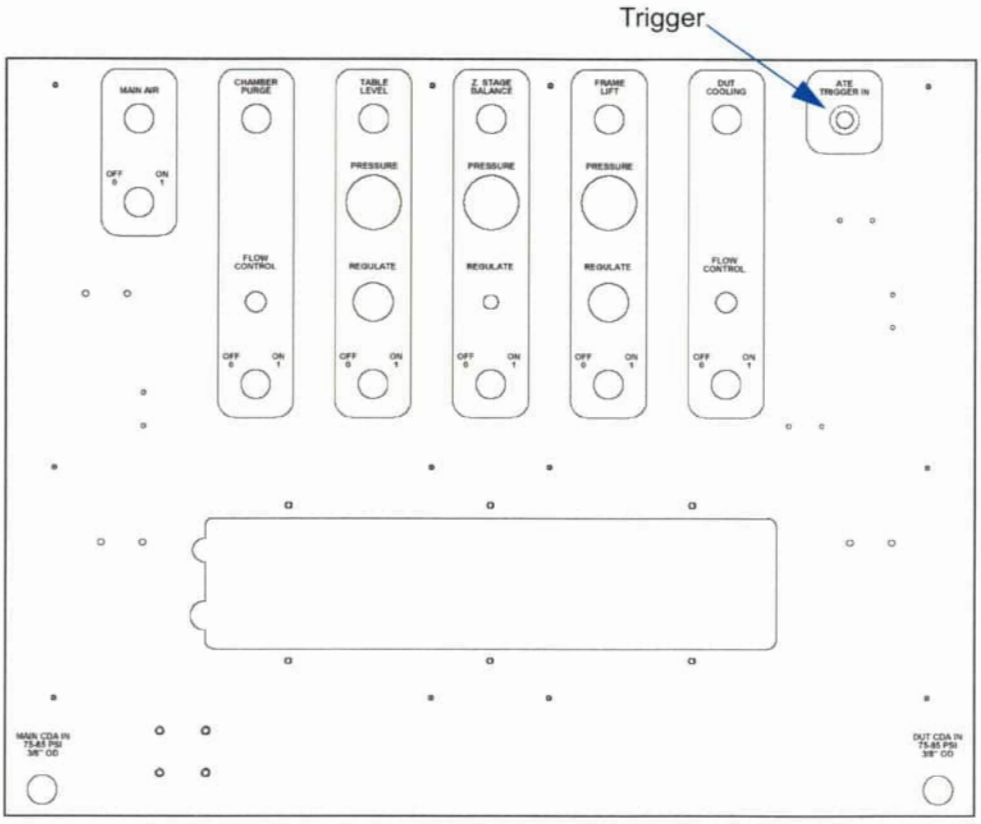
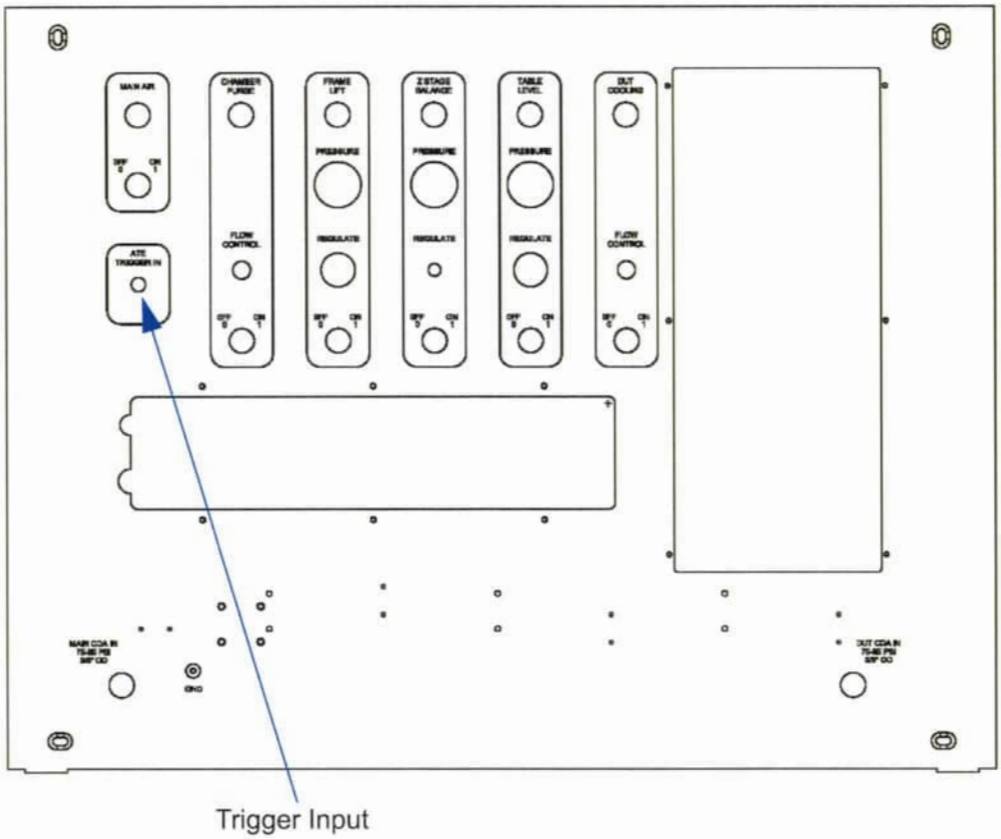


FIGURE 83. EmiScope-II*t* Trigger Input on Pneumatic Panel



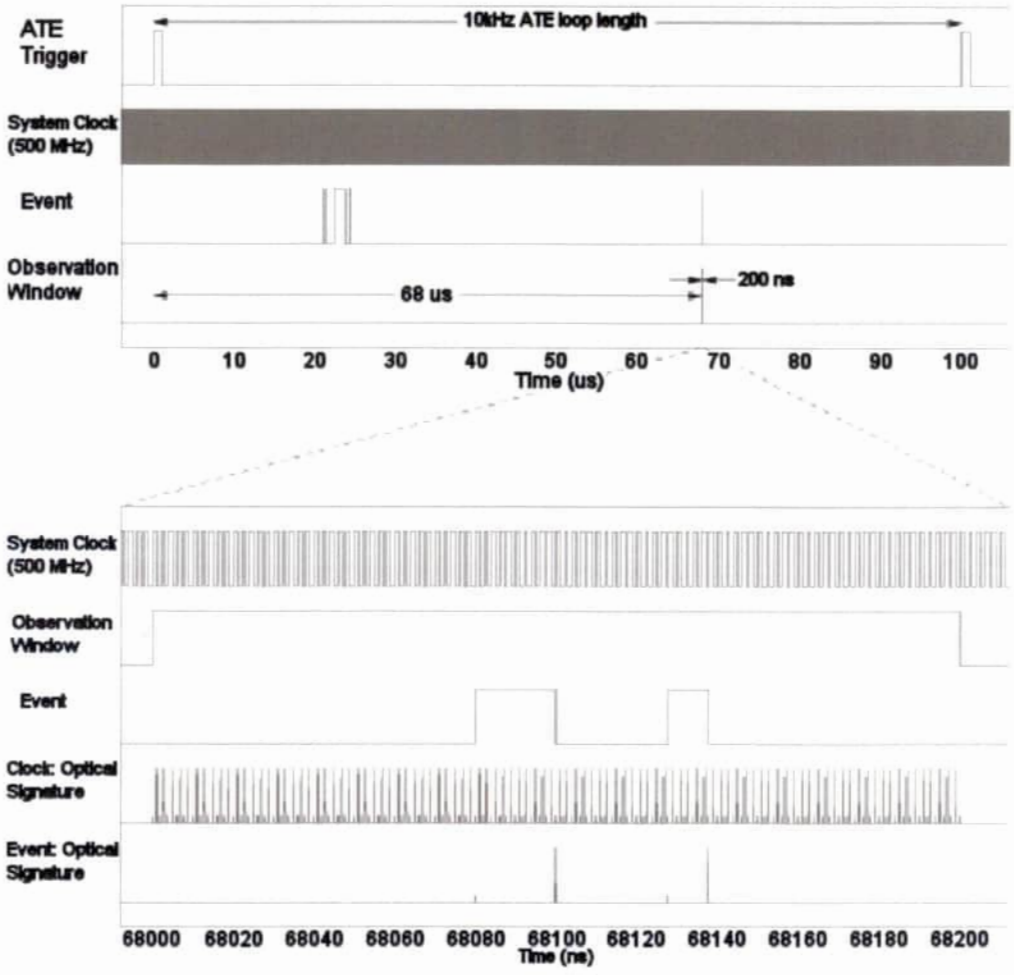
The bottom panel shows a portion of the region shown in the top panel, as it would be recorded by the EmiScope-II. In this example, an event is identified for study that occurs about 68.1µs into the ATE instruction loop. The system is made active during the observation window, which is itself programmable relative to the ATE trigger signal. The resulting data collected, from the selected event and from the master clock, can be used to characterize the observed event.

Once the timing is established, the next step is setting the detector parameters: trigger signal level and edge, and gate offset and width. These parameters are set in the Acquisition Settings control panel. When setting the Desired Gate Parameters. take into consideration any cable delays that may be introduced due to the ATE cable length. Also, it is important to mini-

mize the gate width, since large widths can cause excessive noise for smaller loop periods.

The pTA offset and span width values should be set manually or use the Auto pTA function.

FIGURE 84. **Acquisition Timing**



NOTE: Set the pTA offset smaller than the detector gate delay by at least 80ns.

♦ **To set the acquisition parameters,**

1. Select the Acquisition Parameters control panel.
2. Enter the Offset and Width in the Desired Gate Parameters fields.

3. Enter the input trigger threshold value and select positive or negative polarity.
4. Enter the pTA Offset which is approximately 80ns smaller than the detector offset. and select a pTA span from the Time Span pull down which is closely matches, and is not smaller, than the detector gate width, or use the Auto pTA function.

Acquiring and Monitoring a Histogram

Once the timing electronics are set up, you can start acquiring data. During acquisition you can see photon signal events occurring in the Live histogram. You can select the Current Histogram control panel to see the acquisition time and trigger count increasing, and the trigger rate and event rate updating.

- **To acquire photon data,**

1. Make Live histogram is enabled by selecting the check box in the Histogram List control panel.
2. Click on the Acquisition menu and select the Start command. You can click on the main tool bar shortcut instead of using the menu.
3. Click on the Histogram menu and select the Fit histogram command to center the histogram in the display area. You can click on the main tool bar shortcut instead of using the menu. The exact shape of the Live histogram depends on the detector settings and loop length.
4. To look at a specific part of the histogram, click on the Display menu and select Zoom in X or Zoom in XY. You can click on the main tool bar shortcuts for Zoom in X instead of using the menu.
5. To change the time offset, time scale, vertical offset, or vertical scale, click on the Current Histogram control panel. You can type the new values or use the arrow buttons to change these values.
6. To stop the acquisition click the Acquisition menu and select Stop, or click on the Pause or Stop shortcuts in the main tool bar. To resume the acquisition click on the Resume shortcut. If you start another acquisition instead of resuming the current one, a dialog box appears warning that the Live data will be lost.

Signal Detection and Fitting

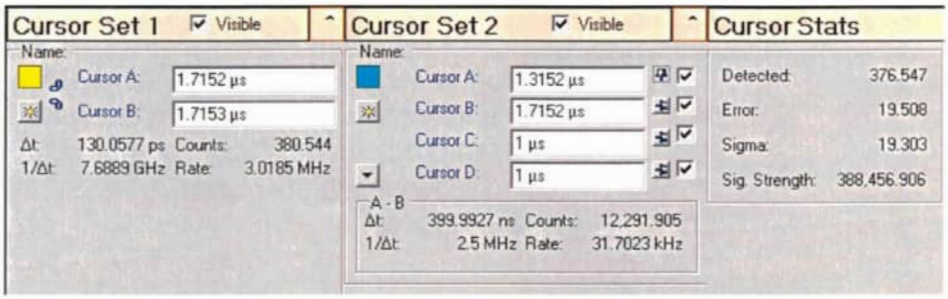
You can use the cursors to measure timing between events, signal detection levels, and Gaussian curve fitting. There are two sets of vertical cursors that are enabled and controlled from the cursors control panels located below the histogram display area. You can also control the cursors from the Cursors menu. When displayed, the cursors can be manually placed by dragging individual cursors in the display area using the left mouse button.

Two sets of cursors are available for use. The primary cursors, Cursor Set 1, are used for displaying the Full Width Half Maximum(FWHM) value for the Gaussian curve fitting function. The secondary cursors, Cursor Set 2, are used for displaying centroid values for the Gaussian curve fitting function. There are two primary cursors, A & B, and four secondary cursors, A, B, C & D.

Both sets of cursors in the Cursors menu have commands each to show and hide cursors, center cursors, and change the color of the cursors. The Show/Hide command allows you to make sets of cursors visible or invisible. The Center command centers the cursors in the histogram display area. The Color command allows the user to change the color of the cursor as desired.

You also have cursor control available in the control panels below the histogram display area (see Figure 85). The control panels let you type in specific times for each cursor and read the time period between the cursors. The colored boxes represent the cursor colors assigned using the menu commands.

FIGURE 85. The Cursor Control Panels



Signal Detection

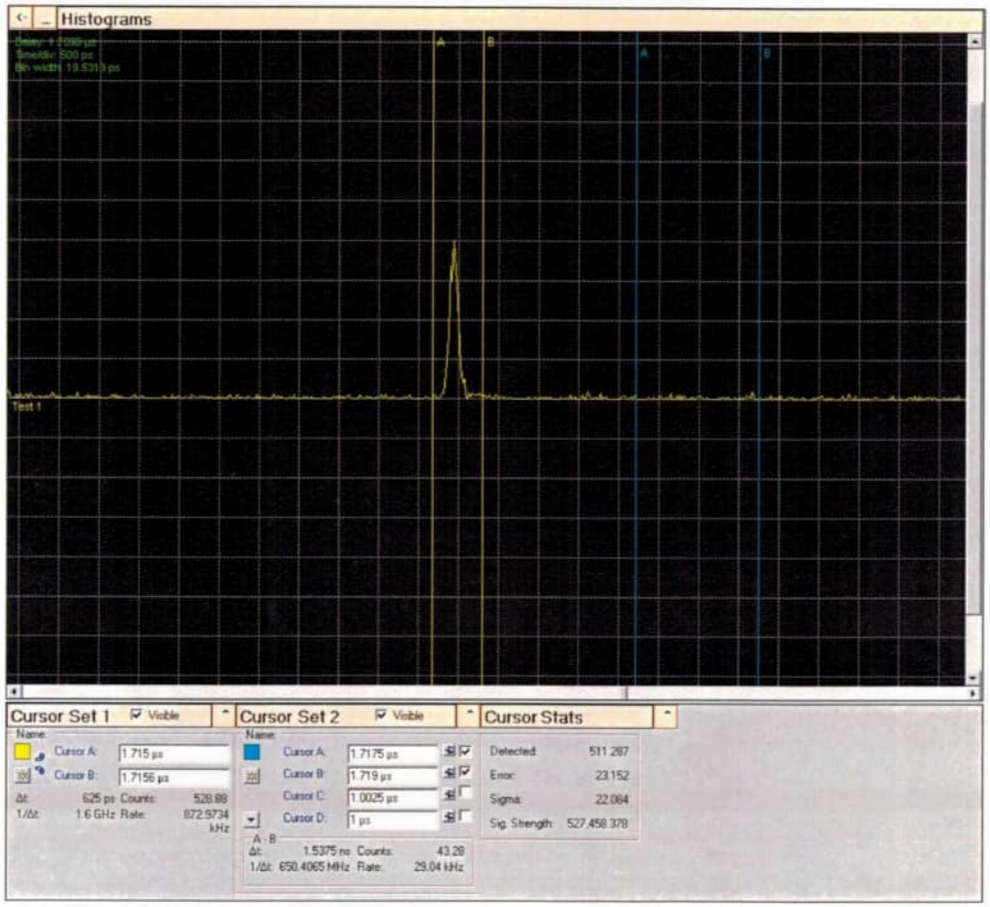
You can calculate the relative signal strength of a histogram peak using the cursors. The exact calculations used to perform these operations are given in "Detection Calculations" on page 164.

- **To measure a signal,**

1. Enable both sets of cursors by selecting the Visible check boxes in the Cursors control panels.
2. Select a histogram, and place the primary cursors around a histogram peak. Place the A&B secondary cursors around a sample of nearby noise (see Figure 86). The number of raw photon counts detected are then displayed in the Cursor Set 1 control panel.
3. In the Cursor Stats panel, the following calculations are performed: detection in photon count units, error in detection in counts, detection in standard deviation units (sigma), and signal strength in parts per billion (ppb).

The counts between the secondary A & B cursors are scaled by time interval of the cursors, and subtracted from the counts between the primary A & B cursors. The error is calculated by taking the Root Sum Square (RSS) of the signal and background errors. The signal strength calculation is the same as the detection in counts, dividing by the number of triggers (loops) and multiplying by a billion.

FIGURE 86. Measuring a Signal



Gaussian Curve Fitting

You can find the centroid time and full width half maximum (FWHM) of signals in a quantitative way by fitting a Gaussian curve to histogram peaks.

- **To find the full width half maximum (FWHM) of a signal,**

1. Place the primary cursors around the peak of interest in a selected histogram as shown in Figure 88.
2. Click on the Histogram menu and select Gauss Fit or use the shortcut in the main tool bar. The primary cursors are placed at the FWHM points and a secondary cursor is placed at the peak centroid.
3. The FWHM is displayed as Δt in the Cursor Set 1 control panel, and the center point is the time position of the secondary cursor.

4. After applying the Gauss Fit function, the software will automatically create a secondary waveform which is linked to the primary waveform. The linked waveform is a graphical representation of the Gaussian fit showing the peak FWHM and values. See Figure 88. Display of the linked waveform can be enabled or disabled from the Histogram List control panel. To enable or disable creation of the linked, Gaussian fit histogram, use the Settings control panel.
5. Click on the Waveform menu and select Show Fit for more accurate FWHM and centroid values.

FIGURE 87. Gaussian Curve Fit, Placing Cursors

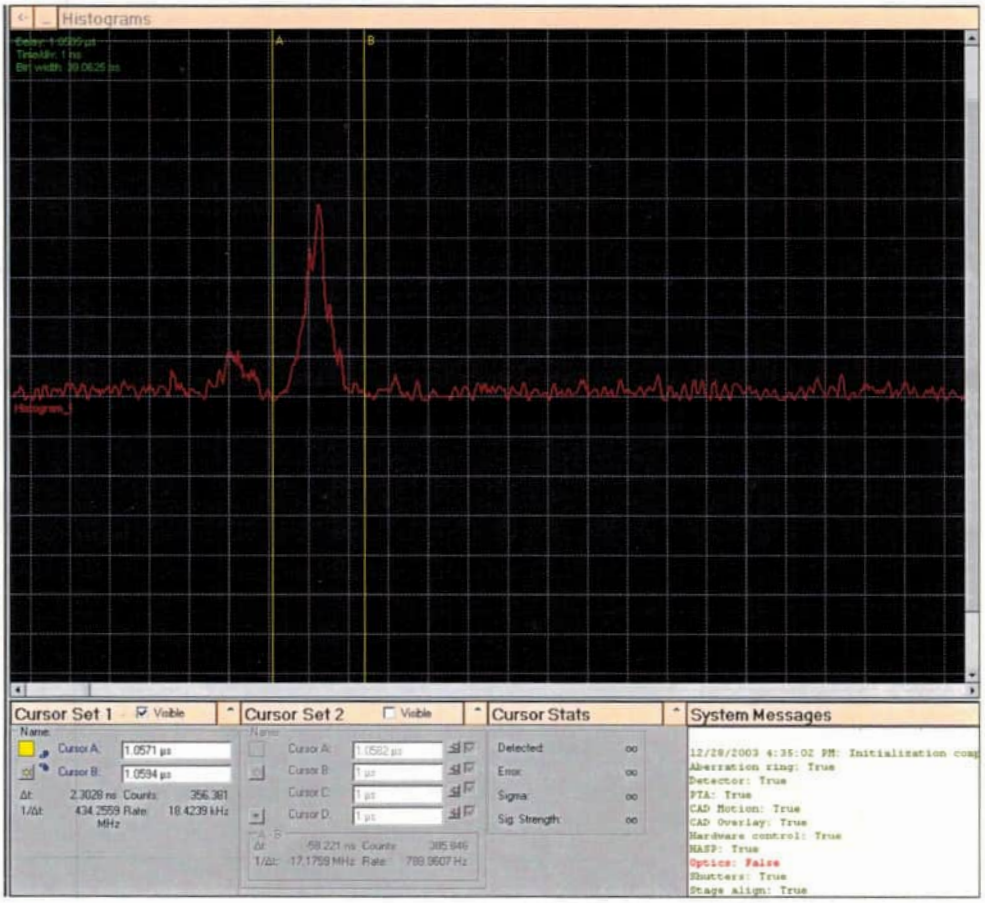
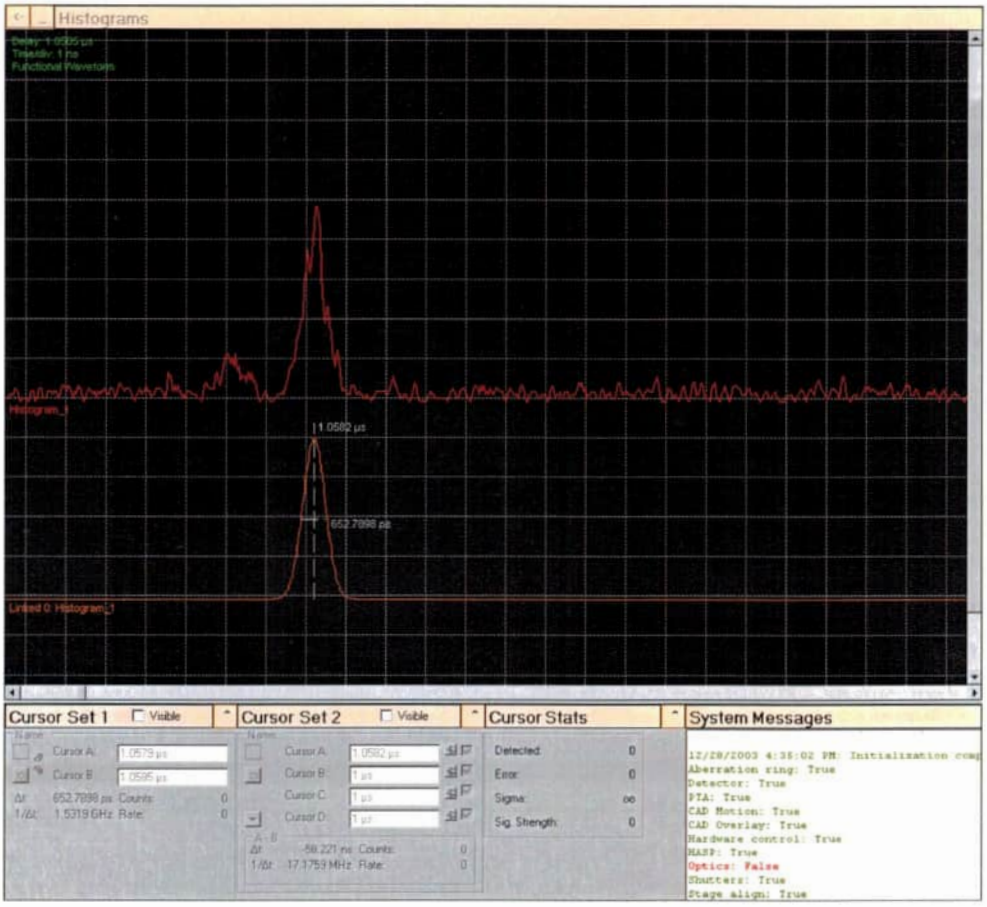


FIGURE 88. **Gaussian Curve Fit, Linked Waveform**



Multiple Peak Gauss Fit

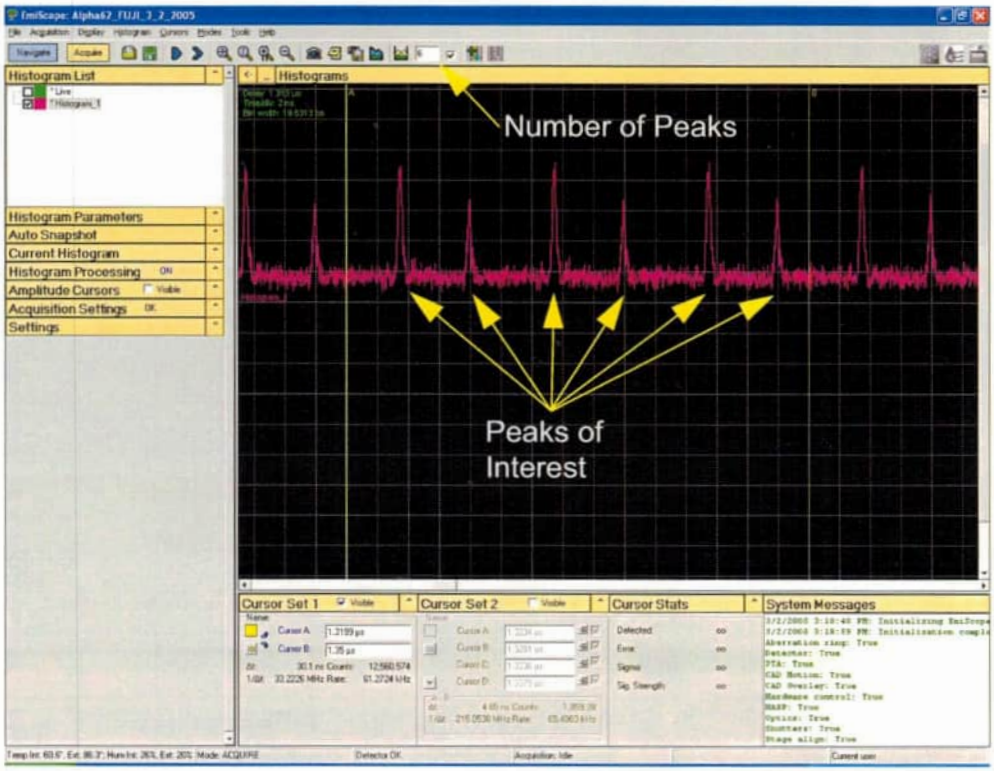
The Multiple Peak Gauss Fit option is used in the EmiScope Acquisition mode to apply various mathematical algorithms to assist you with identifying histogram peaks, applying automatic histogram peak fitting, and histogram to logic waveform conversion. Multiple Peak Gauss Fit is optional software, and may not be enabled on all EmiScope-II systems.

- **To perform a Multiple Peak Gaussian Curve Fit**

1. Select a histogram of interest.

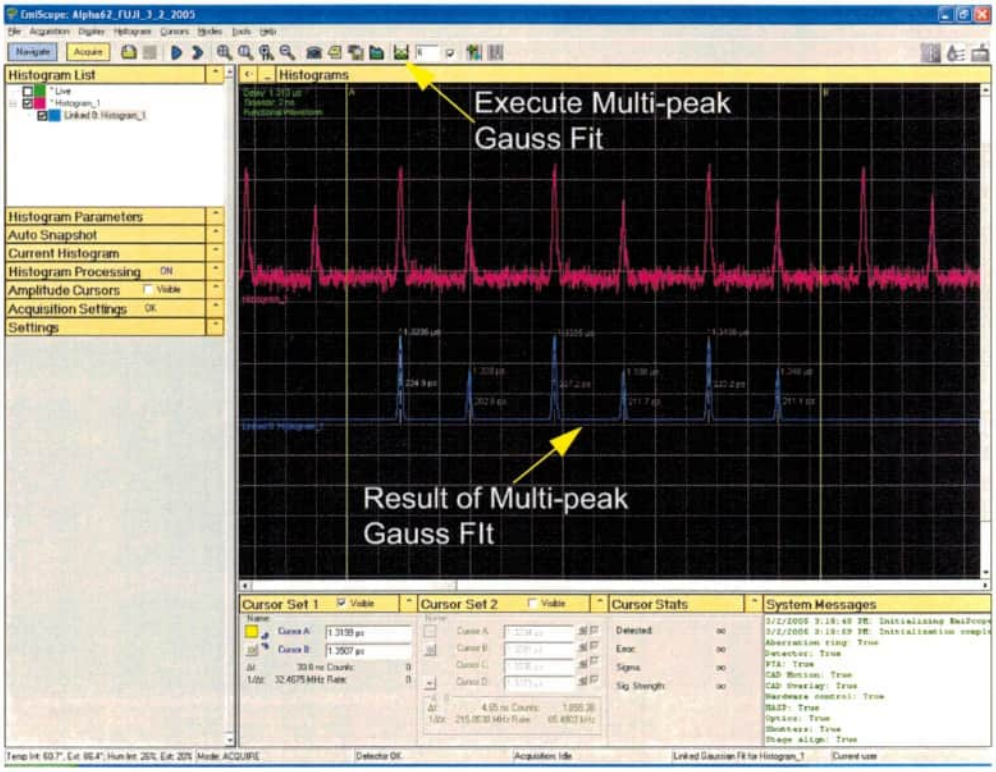
2. Place the A and B cursors using Cursor Set 1 around the peaks of interest in the selected histogram. See Figure 89.

FIGURE 89. Placing Cursors Around Peaks of Interest



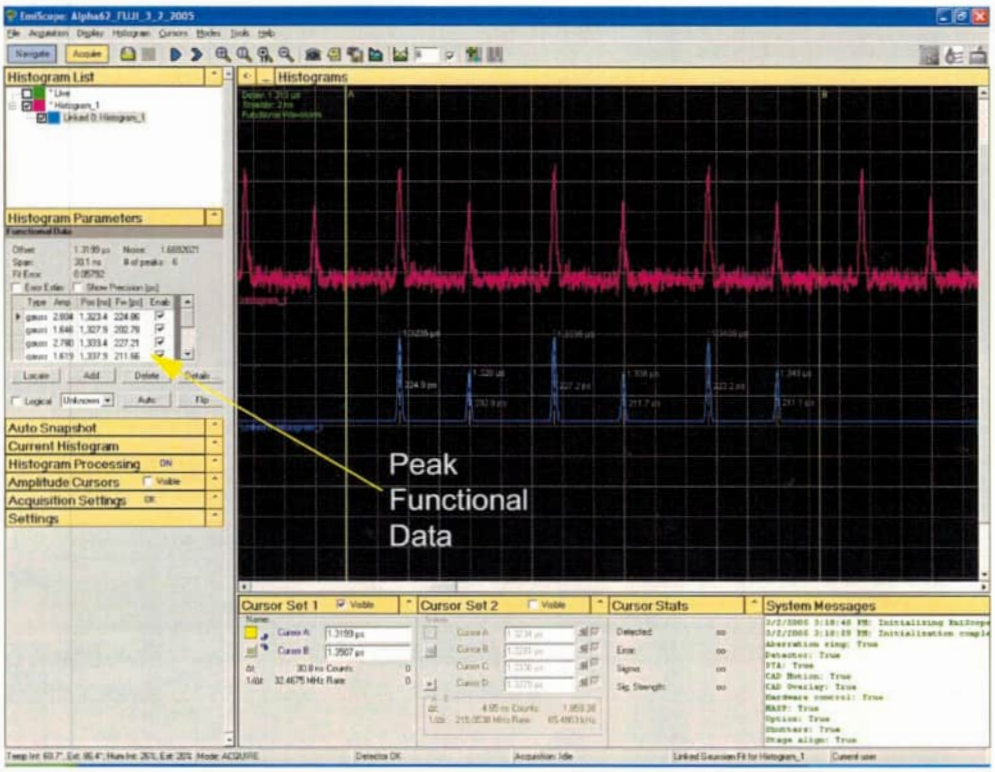
3. For the most accurate curve fit, enable the Number of Peaks check box in the Acquisition mode tool bar, then enter the number of peaks expected in the histogram area, bounded by the cursors, in the Number of Peaks text box. See Figure 89. If the number of peaks is not entered, the software will attempt to automatically determine the number of peaks bounded by the cursors.
4. To execute the curve fitting, select the Multiple Peaks Gauss Fit icon in the main tool bar (Figure 90).

FIGURE 90. Executing Multiple Peak Gauss Fit



5. After executing Multiple Peaks Gauss Fit, a new histogram displaying the peaks found will be automatically created. This new histogram is "linked" to the original histogram data, and is displayed in a nested style in the Histogram List control panel. The linked histogram can be manipulated similar to any other histogram using standard Acquisition mode commands.
6. The peak centroid positions and full width half maximum (FWHM) values of the linked histogram are automatically labeled in the Acquisition mode display area. The labeling can be enabled or disabled from the Plots tab of the Acquisition mode Settings control panel. See Figure 80 on page 140.
7. The curve fitting Functional Data for each histogram peak can be observed by first selecting the linked histogram generated by Multiple Peaks Gauss Fit, and the curve fit data for each peak is displayed in the Histogram Parameters control panel. See Figure 91.

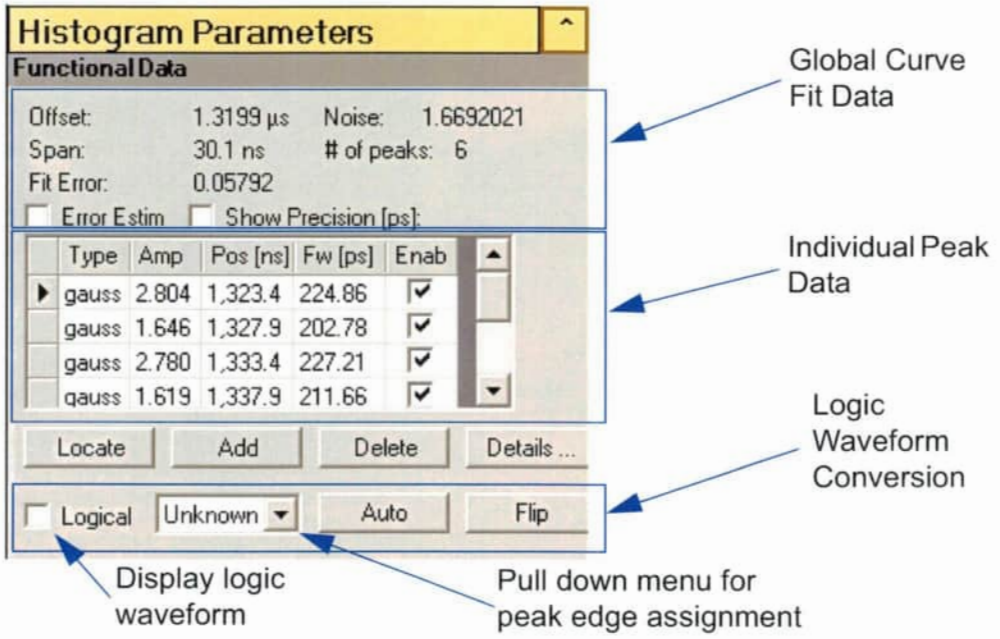
FIGURE 91. Curve Fit Functional Data



♦ **To perform histogram to logic waveform conversion,**

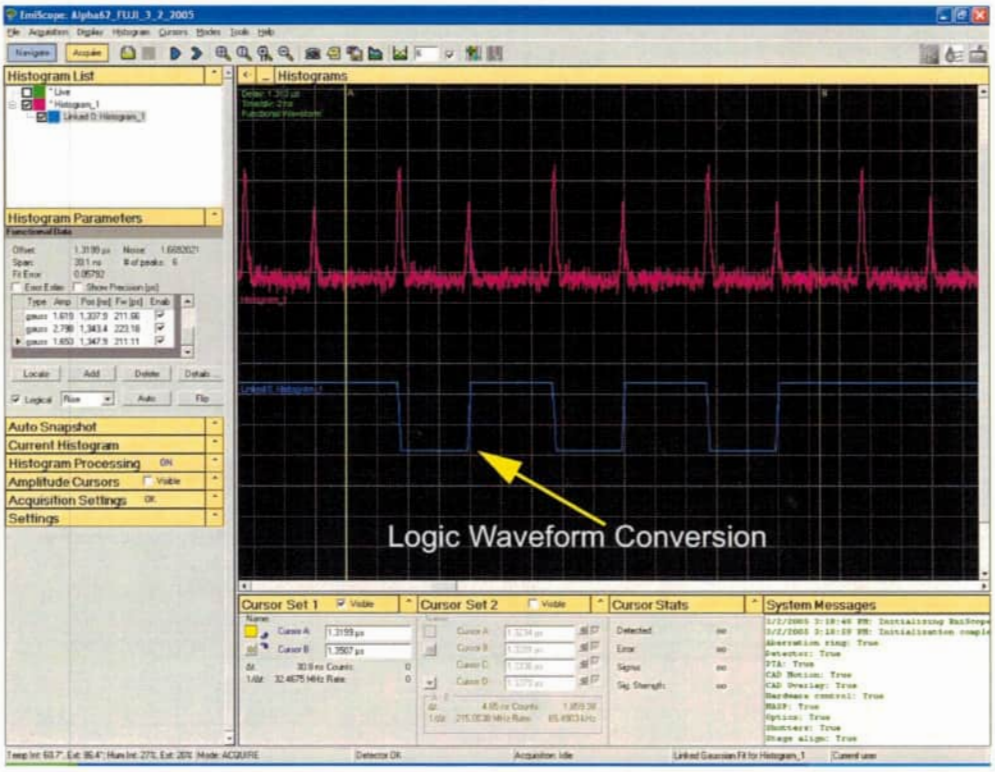
1. To display the histogram as a logic waveform, you need to assign each Gaussian curve peak as a rising or falling edge in the logic waveform. You can make the assignment by selecting the Auto function (Figure 92, “Peak Functional Data”), or manually assign each Gaussian peak as a rising or falling edge by selecting each histogram peak, and assigning rising or falling edge from the drop down text box in the Histogram Parameters control panel.
2. When using the Auto function, the software will assign each Gaussian peak as a raising or falling edge by analyzing the amplitude of the peak, assuming the high amplitude peaks as nMOS (a falling edge), and the low amplitude peaks as pMOS (a raising edge). Upon the completion of the auto-assignment, you can verify the edge assignment by checking the individual peak data. If there is an error, you can correct it by manually assign the peak in the pull down menu (Figure 92).

FIGURE 92. Peak Functional Data



3. Now you can change the Gaussian curve fit into a logic waveform (Figure 93) by selecting the Logical check box (Figure 92). You can toggle between the Gaussian curve and logic waveform by selecting and deselecting the Logical box.

FIGURE 93. Logic Waveform Conversion

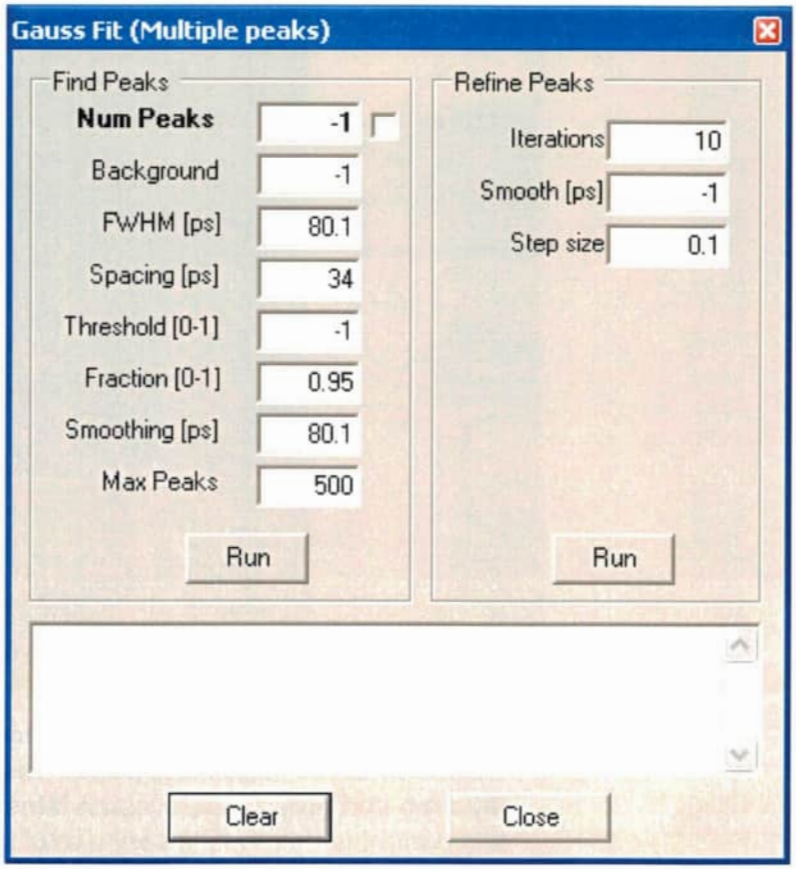


4. This feature can also be enhanced by performing addition of multiple Gaussian curve fitted histograms. To perform the addition, you can simply drag and drop one Gaussian fitted curve to another in the Histogram List control panel. This is very useful when you collect pMOS and nMOS emission histograms separately. Then, you can follow the steps above to convert to a logic waveform.
5. The Flip button can be used to flip rising edge to falling edge, or vice-versus.
6. You can use the Add and Delete buttons to add or delete peaks to a Gaussian curve fitted waveform. See “Add Peak Control” on page 160.

The procedure described above is the short cut to perform Gaussian curve multiple peak fitting. This option is performed using two a step algorithm, Find Peaks and Refine Peaks. You can access this process from main menu (Histogram->Multi-peak Gauss Fit...). The Gauss Fit (Multiple peaks)

panel will appear (Figure 94). This panel can be used to further refine the mult-peak gauss fit algorithm parameters.

FIGURE 94. Gaussian Multiple peak fitting



- Find Peaks is used to coarsely locate peak locations in a histogram. It uses a peak capturing algorithm that triggers when the histogram decreases by a specified percentage after a high point. Several smoothing and triggering options are provided and are described.
- Refine Peaks used to fit the locations of peaks identified by Find Peaks. The resulting fit output may be piped into itself for recursive fitting using a count option allowing multiple iterations.
- The Find Peaks entries, other than Num Peaks, can be left as the default entries.

♦ **To execute Find Peaks in the Gauss Fit (Multiple peaks) panel,**

1. Select a histogram of interest.
2. Place the A and B cursors using Cursor Set 1 around the peaks of interest in the selected histogram.
3. In the Gauss Fit (Multiple peaks) panel, enter the number of peaks, bounded by the cursors, expected in the Num Peaks text box. The default entry, -1, will indicate to the algorithm to attempt to automatically determine the number of histogram peaks. It is recommended for you to enter a value for the expected number of peaks.
4. Select Run from the Find Peaks section of the Curve Fit control panel
5. After executing Find Peaks, a new histogram displaying the peaks found will be automatically created. This new histogram is "linked" to the original histogram data, and is displayed in a nested style in the Histogram List control panel. The linked histogram can be manipulated similar to any other histogram using standard Acquisition mode commands. See Table 16 on page 158 for more information on the Find Peaks parameters.
6. The peak centroid positions and full width half maximum (FWHM) values of the linked histogram are automatically labeled in the Acquisition mode display area. The labeling can be enabled or disabled from Plots tab of the Acquisition mode Settings control panel. See Figure 80 on page 140.
7. After using Find Peaks, you can use Refine Peaks to perform automatic Gaussian fitting to the peaks identified from Find Peaks to improve the peak centroid position and FWHM accuracy.
8. To use Refine Peaks, first select the linked histogram generated by Find Peaks.

Note: The Refine Peaks function can only be executed on a linked histogram generated by the Find Peaks function. If Refine Peaks is executed on any other histogram, the EmiScope software application will display an error.

9. In the Refine Peaks section of the Curve Fit control panel, the most commonly used parameters are Iterations and Step Size. If Refine Peaks is being executed where the number of peaks of the linked histogram are ten or less, the Iterations parameter should usually be set to 100, and the Step Size parameter should usually be set to 0.01. When the number of peaks of the linked histogram are more than ten, the Iterations parameter should usually be set to 1.

Note: When the number of peaks is greater than 10, the Refine Peaks processing time may very long if the number of Iterations is greater than 1.

10. To execute Refine Peaks, select Run from the Refine Peaks section of the Curve Fit control panel. See Figure 94.
11. After executing Refine Peaks, a new histogram displaying the curve fitting results will be automatically created. This new histogram is "linked" to the original histogram data, and is displayed in a nested style in the Histogram List control panel. The linked histogram can be manipulated similar to any other histogram using standard Acquisition mode commands. See Table 17 on page 159 for more information on the Refine Peaks parameters.
12. The peak centroid positions and full width half maximum (FWHM) values of the linked histogram are automatically labeled in the Acquisition mode display area. The labeling can be enabled or disabled from Plots tab of the Acquisition mode Settings control panel. See Figure 80 on page 140.
13. After using Refine Peaks, the curve fitting Functional Data for each histogram peak can be observed by first selecting the linked histogram generated by Refine Peaks, and the curve fit data for each peak is displayed in the Histogram Parameters control panel. See Figure 91.
14. See Table 18 on page 159 for more information on the peak Functional Data. See "Saving Peak Functional Data in .csv Format" on page 161 for more information on saving the peak Functional Data.

Multiple Peak Gauss Fit Reference Information

The following tables describe the parameters of the Gaussian Curve Fit software option.

TABLE 16. Find Peaks Parameters

Parameter	Default	Usage
Num Peaks	-1	Set to the number of peaks to be fitted. For the default value, the algorithm will attempt to automatically detect the number of peaks. It is recommended that the user enters a number of peaks.
Fwhm [ps]	80	Defines the detector width(FWHM). Using the default value is recommended.

TABLE 16. Find Peaks Parameters

Spacing [ps]	100	Defines the minimum spacing between peaks. Using the default value is recommended.
Threshold [0-1]	0.98	Defines the threshold value for peak sensing. Using the default value is recommended.
Fraction [0-1]	0.98	Defines the fraction level decrease which indicates the presence of a peak. If the histogram level decreases to the fraction value of the peak level, then it is marked as a peak, subject to the spacing value. Using the default value is recommended.
Smoothing [ps]	20	Sigma value used for Gaussian smoothing of the histogram when looking for peaks. Using the default value is recommended.
Max Peaks	10	Defines the maximum number of output peaks.

TABLE 17. Refine Peaks Parameters

Parameter	Default	Usage
BG Offset	0	Offset event level added to the background to reduce noise effects at low event counts. Using the default value is recommended.
Iterations	1	Number of times to recursively repeat the algorithm. Can be set to a value greater than 1 when the number of peaks is less than 10.
Smooth [ps]	40	Defines the sigma used in a Gaussian smoothing of the histogram when calculating the Poissonian noise.
Step Size	0.5	Defines the default ratio change per iteration. It is recommended to set this value to 0.01 to increase the stability of the iteration.

TABLE 18. Peak Functional Data Parameters

Parameter	Type	Description
Offset	Global	Defines start time of curve fitting. Equivalent to placement of Cursor A.

TABLE 18. Peak Functional Data Parameters

Span	Global	Defines end time of curve fitting. Equivalent to spacing between Cursors A and B.
Noise	Global	Poissonian noise calculation.
# of peaks	Global	Number of peaks found.
Fit Error	Global	Calculated estimate of statistical error.
Type	Individual	Type of curve fit.
Amp	Individual	Amplitude of the selected peak.
Pos [ns]	Individual	Centroid time position of the selected peak.
Fw [ps]	Individual	FWHM value of the selected peak.
Enab	Individual	When checked, the selected peak is displayed.
Error Estim	Expanded	When checked, displays the calculated error for Amplitude, Position, and FWHM of all peaks.
Show Precision [ps]	Expanded	When checked, displays the calculated precision value of the selected peak.
Locate	Control	Centers the currently selected linked histogram in the Histogram Display Area.
Add	Control	Used to manually add a user defined peak. Manually adding peaks is only recommended for linked histograms resulting from Find Peaks. See "Add Peak Control".
Delete	Control	Used to delete the currently selected peak.
Details	Control	Displays a window for automatic time spacing calculations of all peaks, and displays peak information with more significant digits.
In Bins	Control	When checked, displays peak information in number of bins rather than time.

Add Peak Control

- **To add a histogram peak,**

1. Select a linked histogram generated from the Find Peaks function.
2. Enable Cursor Set 2.

3. Place Cursor A from Cursor Set 2 at the desired peak centroid.
4. Place Cursor B from Cursor Set 2 at a distance from Cursor A that is one-half of the desired FWHM.
5. Select Add from the Histogram Parameters control panel.
6. A text box will appear to allow you to enter a value for the desired peak amplitude.
7. Enter a peak amplitude value and select OK, and the peak will be created.

Saving Peak Functional Data in .csv Format

- **To save histogram peak functional data,**

1. Select a linked histogram generated from Find Peaks or Refine Peaks.
2. In the Acquisition mode main menu bar, select File->Export.
3. Enter a folder location and file name.
4. Select Save, and the select histogram data will be entered into a file using .csv(comma separated values) format.
5. The .csv file can be read by other applications, such as Microsoft Excel, for use in further data analysis or report generation.

Saving and Displaying Histograms

You can save histograms in four file formats: .acq, .pta, .csv, and .pcsv. The native file format is .acq, which saves all the information regarding the hiustogram. It saves the histogram display color, histogram processing information, display scales and offsets. When the file is reloaded, this information for the histogram is displayed exactly as it was saved.

The .pta format only contains the data and main header information: trigger count, span size, etc. Data saved in this format does not include the display information and the acquisition time, and this information will be lost. This file format is provided to support programs which read this file format.

The .csv(comma separated values) format contains the histogram data and main header information: trigger count, span size, etc. Data saved in this format does not include any histogram processing (periodic average or filter). This file format is provided to support programs which read this file format.

The .pcsv(processed comma separated values) format stores histogram data equivalent to the .csv form except any histogram processing is preserved. However, the raw histogram data cannot be recovered when a .pcsv file is reloaded.

For compatibility, histograms saved in the .emiw format can be loaded, but histograms cannot be saved in .emiw format.

You can use the menu commands or main tool bar shortcuts to save histograms.

- **To save a Live histogram,**

1. Click on the Histogram menu and select the Snapshot command. The histogram is saved to a buffer, and given a new color. The new histogram is added to the Histogram List as Histogram*n*, where *n* is a number representing the order in which it was saved.
2. This step is optional. Click on the Histogram menu and select the Description command.Type in a description of the Histogram and include pertinent parameters such as device, device voltage, test program name, etc., if desired.
3. Click on the File menu and select the Save As command. Type in a name that describes the file, select the location to store the file, then click OK.
4. Click on the File menu and select the Save All command to save all histograms in the Histogram List to a file.
5. If you want to save all the histograms currently shown in the display area as an image of the display area, click on the File menu and select the Save Image command. All the histograms currently shown in the display area are saved to a standard image format file (either .jpg, .bmp, .gif).
6. To recall a histogram file, click the File menu and select the Open command.

Status Bar and System Messages

The Status Bar at the bottom of the Acquisition mode window has three active fields. The first field displays system mode change events. The second field display detector information. The third field indicates the state of the photon data acquisition. Additional system status items are displayed in the System Messages panel.

General Reference Information

PTA File Format

The .PTA spectral data files contain the bin-by-bin contents of the PTA histogram in 32-bin integer format. The header is 256 bytes long and consists of the following:

TABLE 19. PTA File Format

Byte offset	Descriptor length	Use
0	2	Must Be -5
2	1	Preset type (0 = Pass, 1 = Data)
3	1	Span units (0 = ps, 1 = ns, 2 = us, 3 =ms, 4 =s)
4	1	Offset units (0 = ps, 1 = ns, 2 = us, 3 =ms, 4 =s)
5	1	Data Type (AA hex = Histogram Data)
6	4	Number of bins in the data that follows (up to 65,536 for 9308 pTA)
10	4	PTA identification number assigned by the system
14	8	Acq. start date (8 characters "MM-DD-YY")
22	8	Acq. start time (8 characters "HH:MM:SS")
30	4	Time span (floating point relative to span units)
34	4	Time offset (floating point relative to offset units)
38	4	Pass or data count (integer, 0 to 4,294,967,294)
42	4	Pass or data Count preset value (integer, 0 to 4,294,967,294; 0 = OFF). Based on preset type)

TABLE 19. **PTA File Format (Continued)**

Byte offset	Descriptor length	Use
46	64	Hardware description (NULL terminated string)
110	64	Sample description (NULL terminated string)
174	2	Number of calibration coefficients (0 or 1 = not calibrated, 2 = Linear, 3 = Quadratic, 4 = Cubic)
176	6	Calibration units (NULL terminated string)
182	32	Calibration Terms (4 double precision values) in increasing powers of time
214	1	Linear Display flag (0 = log, otherwise linear)
215	1	Vertical scale (4 = 16 counts, 5 = 32 counts, up to 29 = 512M counts)
216	4	Display starting bin (integer, 0 to pass length-1)
220	4	Display number of bins (integer, 32 to pass length)
224	4	Marker bin (integer, 0 to pass length –1)
228	4	Starting bin number for the data that follows
232	2	Reserved
234	6	Serial Number (5 ASCII characters with NULL termination)
240	16	PTA ID string (up to 16 chars "9308-001" NULL term.

The next part of the file contains the spectrum stored as 32-bit integers. The number of integers is the number of bins (see offset 6 in the header). This number will always be O 65,536.

Detection Calculations

These are the calculations used in determining the parameters in the Cursors Stats panel.

The number of counts detected, N_d, is given by:

$$N_d = N_s - N_b (T_{s1} - T_{s0}) / (T_{b1} - T_{b0})$$

where:

N_s = Number of counts between the standard or signal cursors.

N_b = Number of counts between the background cursors.

N_l = Number of loops in acquisition.

T_{s0} = Time of earlier standard cursor.

T_{s1} = Time of later standard cursor.

T_{b0} = Time of earlier background cursor.

T_{b0} = Time of later background cursor.

The background noise "rate" of N_b / (T_{b1} _ T_{b0}) is used to determine the number of noise counts between the signal cursors.

An estimate of the standard deviation in the detected counts, E_d, is provided by:

$$E_d = S(N_s + N_b [(T_{s1} - T_{s0}) / (T_{b1} \_ T_{b0})]^2$$

The detection level in standard deviation (sigma) is the ratio of the detected counts and the standard deviation: N_d / E_d.

The parts per billion, PPB, is determined by:

$$PPB = N_d / N_l \times 1e9.$$

CHAPTER 8

Event Logs

You can record selected events generated by the EmiScope-II system. The Event Logger software installed on the EmiScope-II PC is designed to record and time stamp information such as application run time, system usage by user, and actions taken while the EmiScope-II software application is in use. The Event Logger software records events from the following clients:

1. Acquisition
2. Navigation
3. System
4. Video

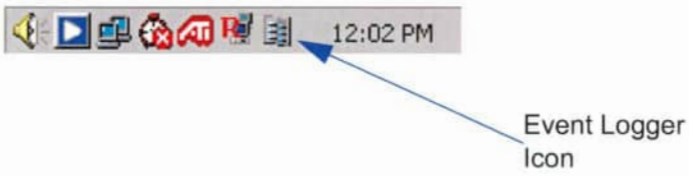
Event Logger creates a log in Microsoft Jet (.MDB) database format, which can be viewed using Microsoft Access or other MDB file viewer.

Event Logger is a COM server implemented in an EXE file. Its lifetime is controlled by the operating system. Event Logger is automatically launched when the EmiScope-II software application is started. It ends when the EmiScope-II software application exits.

NOTE: You should not try to manually launch and run the Event Logger program.

When the Event Logger application is running, it inserts an icon into the system tray area of Windows task bar (see Figure 95). This icon is removed from the Windows task bar when Event Logger is not active.

FIGURE 95. Event Logger System Tray Icon



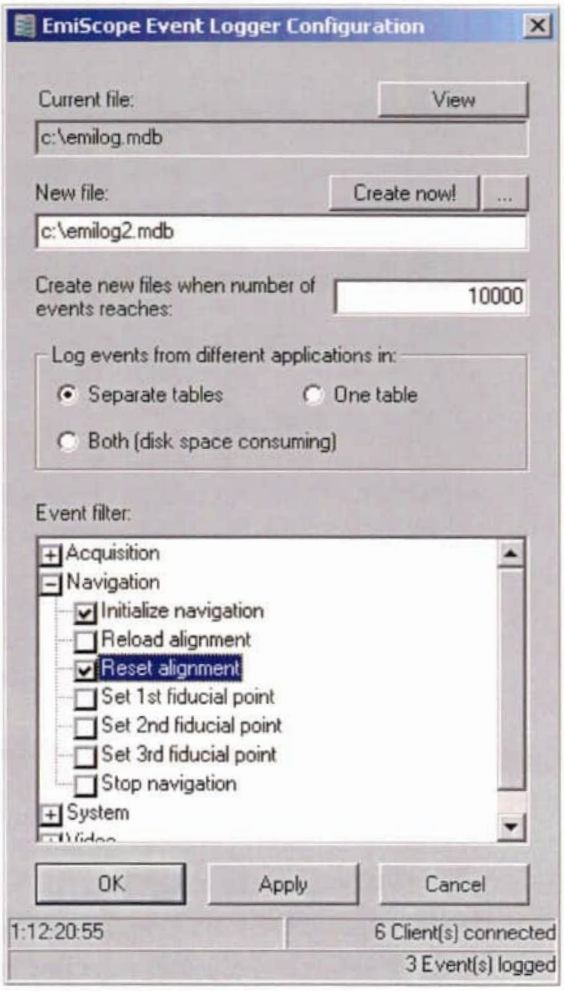
Configuring Event Logger

You can configure the events Event Logger collects from each client, create new log files, view the current active log file and previously saved history logs.

- **To configure Event Logger,**

1. Double click on the Event Logger icon in the system tray. Or right-click on the system tray icon and then select Open from the popup menu. Using either one of these methods opens the EmiScope-II Event Logger Configuration dialog box (see Figure 96).
2. Enter the number of events to save in a log file before a new log file is created.
3. Configure how the Event Logger file is to log events. You can log events from different clients in one table, in separate tables or both.
4. Configure the events to collect for each client in the Event filter field.
5. Then click OK to apply the changes made and close the dialog box. Or click on Cancel to revert to the previous settings and close the dialog box.
6. To close the Event Logger Configuration dialog box, click on the close window button in the top right of the title bar, or click on Cancel.

FIGURE 96. **Event Logger Configuration**



Viewing Log Files

The event log files are saved in Microsoft Jet (.MDB) database format, and the default viewer is Microsoft Access. However you can use other database application programs to view the log files.

- **To view a log file,**

1. Double click on the Event Logger icon in the system tray, and select the View button. If installed, Microsoft Access automatically launches and opens the current log file. The current log file is a read-only file.

2. If you do not have Microsoft Access on your computer, open the log files from within your MDB database application. The default log file name and location is "c:\emilog.mdb".

Creating New Log Files

Event Logger runs automatically in the background. New log files are created when the maximum number of events specified in the Event Logger Configuration dialog are recorded. The maximum number of events stored for the client applications can be modified as desired.

The default Event Logger file name format is:

File__XXXX.mdb

where File is the original file name and __XXXX is a four-digit file name modifier. The first time Event Logger runs the default log file is "C:\emilog.mdb" and the default number of events is 10,000. When 10,000 events are recorded, Event Logger creates a new log file named "C:\emilog__0000.mdb". When this file is full again, a new file named "C:\emilog__0001.mdb" will be created.

You can choose a different file name and path for the next new file instead of the default path and file name. The new log file name will be used at the next automatic file creation.

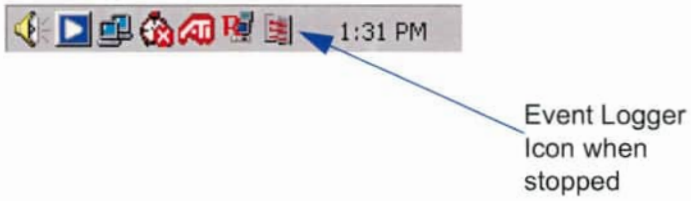
♦ **To create a new log file,**

1. Open the Event Logger Configuration dialog box.
2. Click in the New file text box and type the new file name and path for the log file. You can use the "..." button to browse for a new file name.
3. Click on the Create Now! button to create a log file with the new file name.

Stopping and Restarting Logs

You can stop and restart Event Logger. When you stop event logging, the Event Logger icon in the Windows system tray is changed. See Figure 97.

FIGURE 97. **Event Logger Stopped**



- **To stop and restart event logging,**

1. Right click on the Event Logger icon in the Windows system tray.
2. Select the Stop or Start command from the pop up menu.

Status Display

There are three status display boxes at the bottom of Event Logger configuration dialog box (see Figure 96). A clock on the left-hand-side of the first status bar shows the up time of the Event Logger. The right side of the first status bar shows the number of clients currently connected to Event Logger. The bottom status bar displays the total number of events logged since Event Logger started.

Event Tables

Event Logger organizes recorded events into tables. You can select the events to log from the Event Logger Configuration dialog box. The Event filter contains a list of events that you can activate to log for each client (see Figure 96).

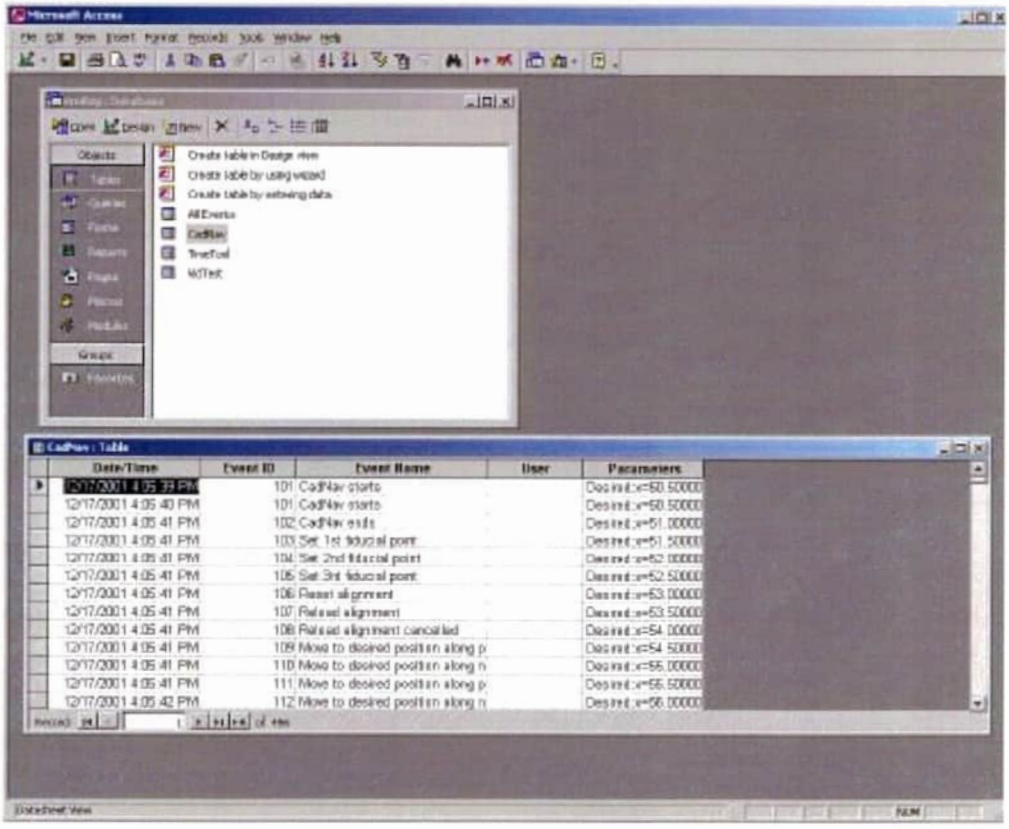
By default, Event Logger creates a table for each client. Events from each client are saved in the corresponding table (see Figure 98). You can also configure Event Logger to save all events in one table.

Event data is logged as rows in the tables. All events have five columns. Depending on the event, some of these columns might be empty.

- **The data columns in an event log file include,**

1. Date and time when the event occurs
2. An event ID
3. The event name or a brief description of the event
4. The name of user logged in who triggered the event
5. Associated event parameters, such as the coordinates of the fiducials points.

FIGURE 98. Event Log Tables



CHAPTER 9

Installation and Maintenance

The EmiScope-II is composed of subsystem modules and replaceable devices. This chapter describes the EmiScope-II facilities requirements, installation procedure, and service. EmiScope-II service is performed on-site by the removal and replacement of the failing subsystem or device. EmiScope-II installation and service is performed by trained Credence personnel only.

Service Safety

This section describes the safety precautions to be observed during EmiScope-II installation and service. It also describes the EmiScope-II safety interlocks that protect personnel from exposure to potentially hazardous situations, and prevent damage to the system components. Safety interlocks are tested every six months during the scheduled system service. The safety interlock is intentionally violated to confirm that it is operating properly.

The following safety interlocks are present in the EmiScope-II:

- Optical table panel interlocks

- Fixture interlocks
- Emergency Machine Off (EMO) button
- Stages Stop button
- Z-stage interlock
- Z-stage position indicator lights

Optical Table Panels

The EmiScope-II optical table panels are equipped with interlocks that disconnect AC power to the system if activated. The front panel and both side panel interlocks are triggered when either of the panels are removed and the system is automatically shut down.

The system should not be operated with any of its panels removed. If it is observed that the system is missing panels or in a partially assembled or disassembled state, Credence technical support should be contacted immediately to restore the system to a user safe state.

Fixture Interlocks

The fixture interlock switch serves to render the system inoperable when a proper DUT fixture is not present. When this interlock is tripped, the laser is de-energized, the Z stage moves to the home position, and the XYZ stages and turret are de-energized.

Emergency Machine Off (EMO)

The EmiScope-II has two or three Emergency Machine Off (EMO) buttons, based on system type. The EMO is used to bring the system to a safe shut-down condition in an emergency to ensure the safety of personnel and equipment. It is designed to be used when personnel and/or equipment are in danger from mechanical crashes, such as objective crashes, turret obstructions, stage obstructions, and aberration ring obstructions.

The EMO buttons are large, red mushroom shaped buttons with a yellow background. One EMO is located on the front door of the electronics rack, and the second EMO is located on the front panel of system controller inside the electronics rack. On the EmiScope-II*t*, a third EMO is located on the user control pad. The EMO is a push activated switch. When an EMO button is pressed, the EMO circuit is activated and all components are

placed in a safe shut down condition, then the entire system is de-energized. See Figure 99.

NOTE: The EMO circuit must be used only in Emergency Situations. Whenever possible, use normal system shutdown procedures rather than using the EMO circuit to power down.

NOTE: Pressing an EMO button does not remove power to the EmiScope-II PC.

Pressing an EMO button will cause a loss of all information stored in the detector and controller system. Data stored in the data acquisition buffer and stage controller will be lost and must be recovered during initialization.

FIGURE 99. EmiScope-II System Controller

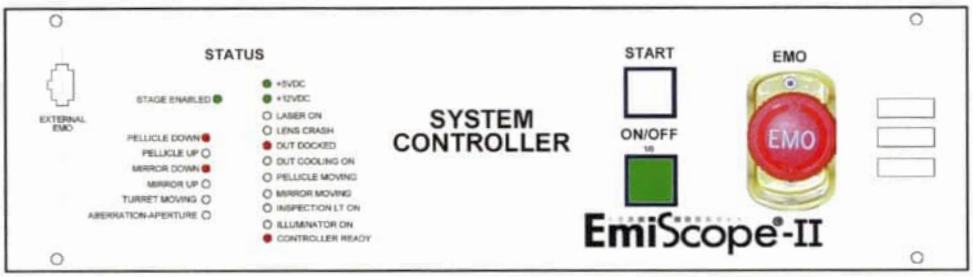
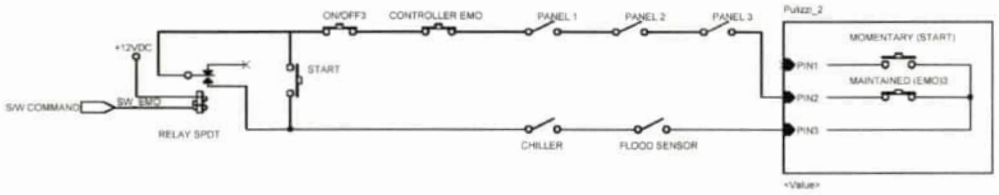


FIGURE 100. EMO Button on EmiScope-II Controller Front Panel

You can reset power by pulling the EMO button out and pushing the start button on the system controller. Use EMO buttons for emergencies only, not for normal shutdown procedures.

FIGURE 101. EmiScope-II Interlock Schematic



Stages STOP Button

The stages Stop button removes all power from the x-, y-, and z-stage motors causing stage movement to stop immediately and is provided to protect hardware from stage, turret and/or user failures. It is a red push button located on the User Control Pad. Pressing the STOP button removes power from the stages and the turret controller. However, power is still present in the EmiScope-II Controller. No information is lost when the STOP button is pressed. However the stages may need to be re-initialized.

FIGURE 102. STOP Button on EmiScope-II Control Pad

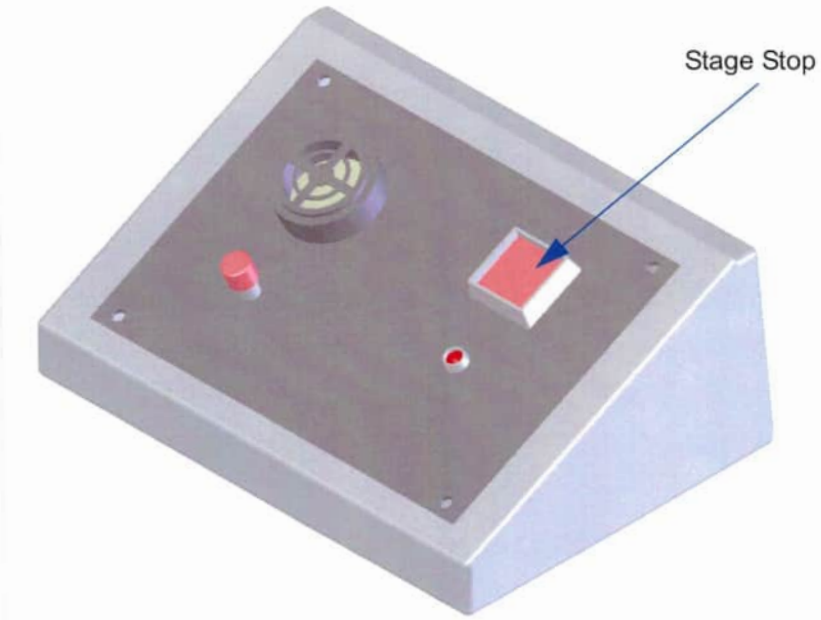
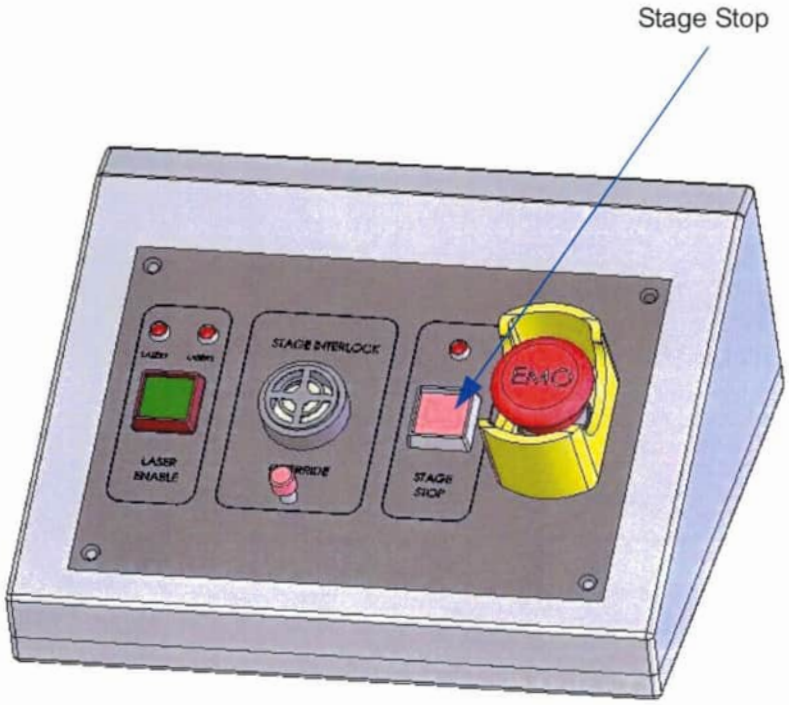


FIGURE 103. STOP Button on the EmiScope-II*t* Control Pad



Note: The Stages STOP button is also available in the Navigation control panel. See "Navigation Control Panel" on page 78.

Z-Stage Interlock

The z-stage limit switch is located on the high magnification objective lens. It is activated if the lens comes into contact with a force resistive object causing the depression of the lens limit switch. Such an action enables a z-stage interlock, and a warning buzzer will sound until the interlock is cleared. The interlock is cleared by pressing the Stage Override button and moving the stage away from the resistive object. See "Clearing a Crash" on page 29.

Z Stage LEDs

The z-stage indicator lights are used to determine whether the z-stage is in its minimum position. When the z stage is in the minimum position, the green LEDs on the vibration isolated table are illuminated. When the red LEDs are illuminated, the z-stage is not in the minimum position.

Optical Path

The EmiScope-II has an interlock which removes power from the Optical Path translation stages (handler) when the optical path is exposed. This interlock is cleared when all exposure to the handler motion is eliminated.

Ergonomics

The EmiScope-II is a mobile diagnostic tool designed to roll on casters. The Frame Lift pneumatic actuator should be used to lower the table frame and engage the use of the casters. Care should be taken to ensure injuries do not result when moving the system.

Since the system is designed to direct dock to ATE, be careful when using the EmiScope-II in the vicinity of ATE with movable test heads or manipulators. It is possible to secure the EmiScope-II system to the floor.

Equipment Cleaning

The EmiScope-II should be used in a controlled environment and should not require any component cleaning.

Exchanging the EmiScope-II Lenses

Certain device package types or device fixturing may prevent usage of the Solid Immersion Lens(SIL). For example, a cavity up BGA package type requires the die mounted on one side of a PCB, and the SIL would be required to approach from the opposite side to gain access to the silicon backside. In this example, there must be an access hole in the PCB through which the SIL can access the silicon backside. In most cases this access hole cannot be made large enough for the SIL to pass through. One solution

is to use a set of lenses with greater working distance. The EmiScope-II can use multiple lens sets in the turret. The lens sets described in Table 20 on page 180 are supported on the EmiScope-II.

Note: Exchanging the EmiScope-II lenses requires assistance by Credence technical support.

TABLE 20. EmiScope-II Lens Sets

Lens Set	Low Magnification	High Magnification
Solid Immersion	20x	220x SIL
Short Working Distance (SWD)	20x	100x
Long Working Distance (LWD)	20x	100x
Liquid Immersion (LIO)	20x	100x
Long Working Distance Solid Immersion	20x	70x LWD-SIL

Replacing the Solid Immersion Lens(SIL) Tip

Occasionally, the tip of the SIL may require replacement. The SIL tip is the part of the lens that makes contact with the device silicon during normal system usage. Contact between the SIL and device silicon is repeated many times during a probe session. Although the SIL tip has been factory tested for integrity during thousands of SIL landings, the tip may require replacement due to normal wear and tear.

Note: Exchanging the EmiScope-II lenses is a Superuser function. See "Superuser Functions" on page 49. Use extreme care if replacing the SIL tip. Incorrect replacement may cause unpredictable system response, equipment damage, and/or DUT damage. For more information, contact Credence technical support.

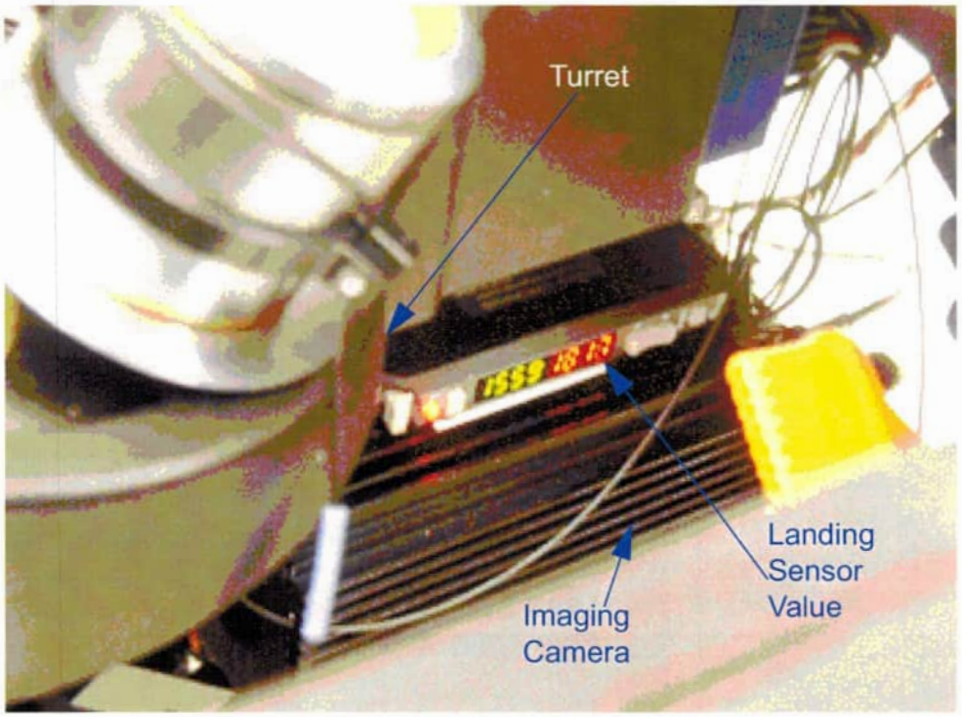
CAUTION: To avoid injury to personnel and equipment, read the Safety section prior to performing any of these procedures. These procedure should only be performed by qualified personnel. See the document Preface sections

"Hazard Levels" and "Visual Hazard Alert Symbols", and "Safety" on page 7 for important safety information.

- **To replace the SIL tip,**

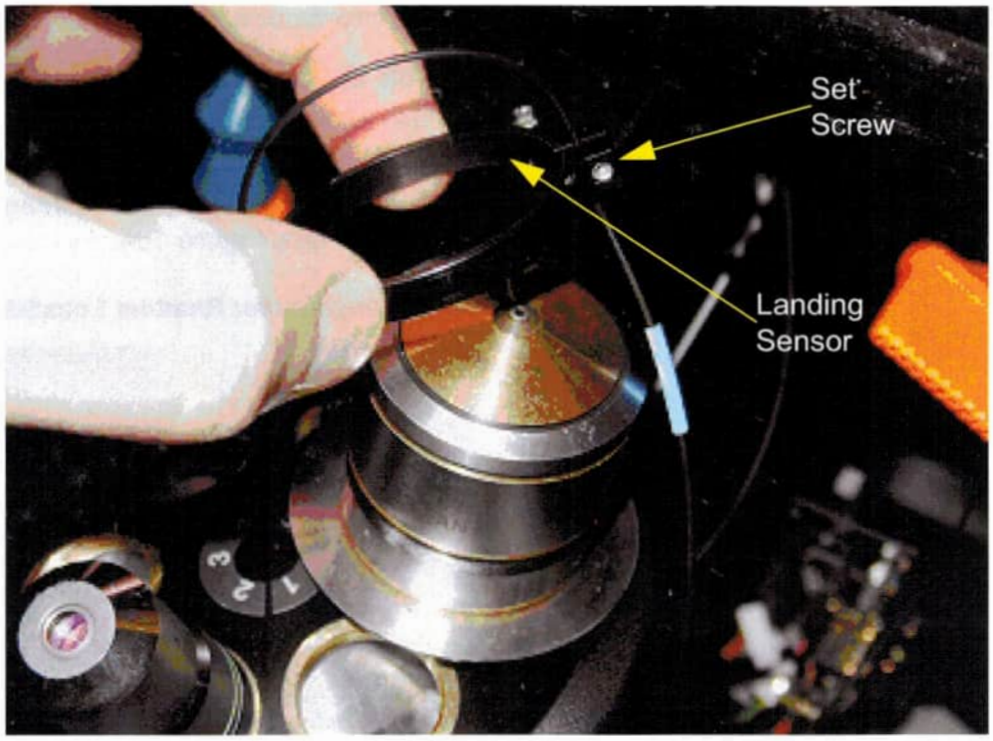
1. Remove any device fixturing from the EmiScope-II.
2. Before removing the SIL, take note of the landing sensor value. The landing sensor is mounted on top of the imaging camera and is a number displayed in red. See Figure 104.

FIGURE 104. Landing Sensor Readout Location



3. Using an 0.035 inch Allen wrench, loosen the landing sensor set screw and remove the landing sensor. See Figure 105 on page 182.

FIGURE 105. Removing the Landing Sensor

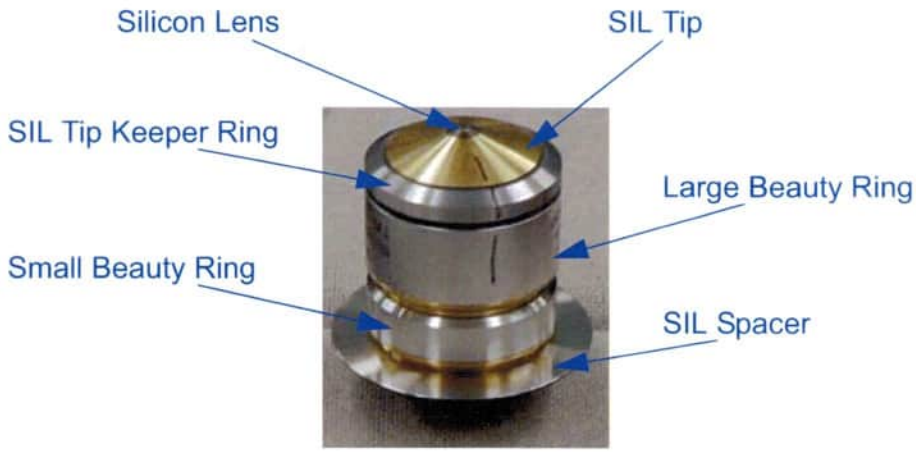


4. Once the landing sensor is removed, the SIL stage interlock alarm on the user control pad will sound.
5. To remove the SIL from the turret, grasp the SIL by the large beauty ring and remove by carefully rotating it counter-clockwise. Take care not to touch the top or bottom of the lens or damage the SIL tip. See Figure 106 on page 183.

FIGURE 106. Removing the SIL from the Turret

6. Note the components of the SIL. See Figure 107 on page 184.

FIGURE 107. Solid Immersion Lens Components

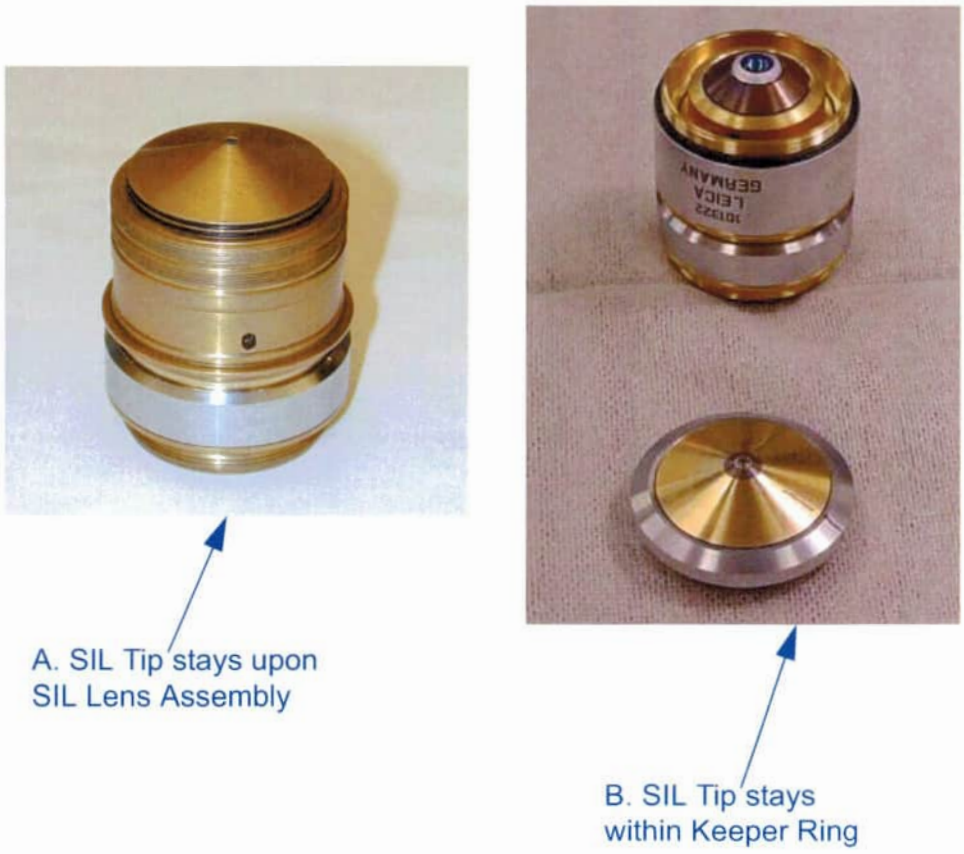


7. Remove the SIL Tip Keeper Ring by unscrewing. See Figure 108 on page 185.

FIGURE 108. Removing the SIL Tip Keeper Ring

8. Upon removal of the SIL Tip Keeper Ring, the SIL Tip will either:
   A. Stay upon the SIL lens assembly.
   B. Stay within the Keeper Ring.
   See Figure 109.

FIGURE 109. SIL Tip after Keeper Ring Removal



9. For case A., proceed to the next step. For case B., proceed to step 8.
10. Remove the small O-ring dust seal using a small screwdriver or other tool with a fine tip. See Figure 110.

CAUTION: The SIL tip o-ring is very delicate. Use extreme care when removing and handling.

FIGURE 110. SIL Tip O-Ring Removal

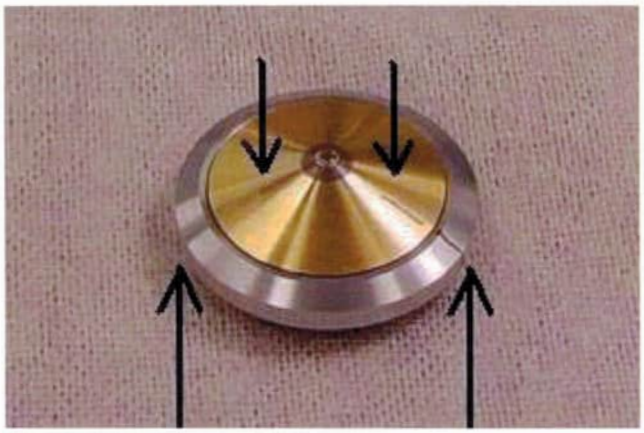
11. Use a small screwdriver or similar tool to gently slide the SIL Tip from the SIL body. The SIL Tip slides up and away from the SIL body. Once the tip is loosened, it can be removed by hand. See Figure 111.

CAUTION: Do not pry the tip away from the SIL body from only one side. Damage to the lens may result. Use gently pressure to push the tip upwards from all sides of the SIL body.

FIGURE 111. Removing the SIL Tip from the SIL Body

12. To remove the SIL Tip from the Keeper Ring, place the SIL Tip on a hard, level surface, and gently press the tip out from the Keeper Ring using finger tip pressure at the locations indicated in Figure 112.

FIGURE 112. Removing SIL Tip from Keeper RIng



13. Remove any remaining O-ring dust seals as described in Step 6.
14. Transfer the O-ring dust seals to a new SIL Tip.
15. Gently press the new SIL Tip onto the SIL body until it is seated. The SIL Tip fits the SIL body with close tolerances. The tip must be pressed straight down onto the body to seat properly.

CAUTION: Do not touch the silicon part of the SIL Tip. Damage and/or performance degradation may result.

16. Screw on the SIL Tip Keeper Ring until snug.
17. Replace the SIL onto the EmiScope-II turret.
18. Perform lens offset and table tilt calibrations, if necessary.

Potential Hazards

During installation and service, there is exposure to two types of potential system hazards:

- Electrical
- Pneumatic

Electrical Hazards

All electrical hazards are self contained within the module or subsystem and clearly designated as such. All subsystems and modules contain non-conductive physical barriers or ground wire connections. However, access to an electrically hazardous area can occur during the maintenance or service of the system. These electrically hazardous subsystems are enclosed within panels clearly labeled, identifying the potential hazards when the panels are removed. Access to electrically hazardous areas are limited to trained Credence employees only after the system is in a powered off state.

Pneumatic Hazards

Pneumatic hazards are present in the form pinch points between the "floating" vibration isolated table and the light-tight box chassis and stored air pressure within the system.

WARNING: Do not insert limbs, digits, or any other part of the body in the region between the vibration isolated table top and the table frame chassis.

WARNING: Stored high air pressure exists; 75 psi - 85 psi.

In the event of a supply pressure or loss or an intentional removal of system pressure by valve closure or supply hose removal, the vibration isolation table will tend settle onto the chassis frame resulting in a pinch point. The EmiScope-II pneumatic system regulators are equipped with pressure release valves set to 7 psi above the regulator setting. These release valves eliminate the possibility of a stored pressure build-up that exceeds the system design.

Energized Electrical Work Types

The Safety Guidelines for Semiconductor Manufacturing Equipment (SEMI S2-0703) defines four types of electrical work. The four types are:

TABLE 21. Electrical Work Types

Type 1	Equipment is fully de-energized.
Type 2	Equipment is energized. Energized circuits are covered or insulated. Type 2 work includes tasks where the energized circuits are or can be measured by placing probes through suitable openings in the covers or insulators.

TABLE 21. Electrical Work Types (Continued)

Type 3	Equipment is energized. Energized circuits are exposed and inadvertent contact with uninsulated energized parts is possible. Potential exposures are no greater than 30 volts root mean square (RMS), 42.2 volts peak, 60 volts DC or 240 volt-amperes in dry locations.
Type 4	Equipment is energized. Energized circuits are exposed and inadvertent contact with uninsulated energized parts is possible. Potential exposures are less than 30 volts rms, 42.2 volts peak, 60 volts DC or 240 volt-amperes in dry locations. Potential exposures to radio-frequency currents, whether induced or via contact, exceed the limits in Table A5-1 of Appendix 5 of SEMI S2-0703.

The applicable electrical work types are indicated in the safety information provided at the beginning of each procedure.

Lockout/Tagout

The lockout/tagout procedures must be followed before servicing the EmiScope-I. Any EmiScope-II service tasks must only be performed by qualified and authorized service technicians.

Lockout and tagout all of the following potentially hazardous energy sources:

- Lockout on main disconnect of Power Distribution Unit
- Lockout on main disconnect of Electronic Controller Box
- Lockout using key on main air disconnect of Pneumatic Panel

When the Power distribution unit is opened at the Main disconnect, all incoming electrical power is removed from the equipment on load side of disconnect. The Main disconnect also has energy Isolation (LOCK-OUT) capabilities.

There is a MAIN over current protection device is rated for 5000 rms Ampere Interrupt Capacity (AIC). The cord and plug are rated for no greater than 240V Line-to-Line/150 Volts Line-to-Ground and Greater than 2.4KVA.

System Shutdown

The Main Energy Isolation (Equipment Supply) disconnect and the pneumatic panel disconnect are readily accessible and lockable only in the de-energized position.

- **To shut down the equipment in an orderly manner,**

1. Locate and operate all the equipment's energy isolating devices.
2. Affix energy isolating (LOCK-OUT) devices.
3. Relieve any stored energy.
4. Verify energy has been isolated and de-energized.
5. Properly Release the equipment from its isolated state.

- **To lockout and depressurize pneumatic panel air pressure,**

1. Rotate MAIN air valve switch to OFF position and remove key.

Hazardous Energy Isolation

Table 22 identifies potentially hazardous energy sources that are present when operating the EmiScope-II, and isolation methods.

TABLE 22. Hazardous Energy Isolation

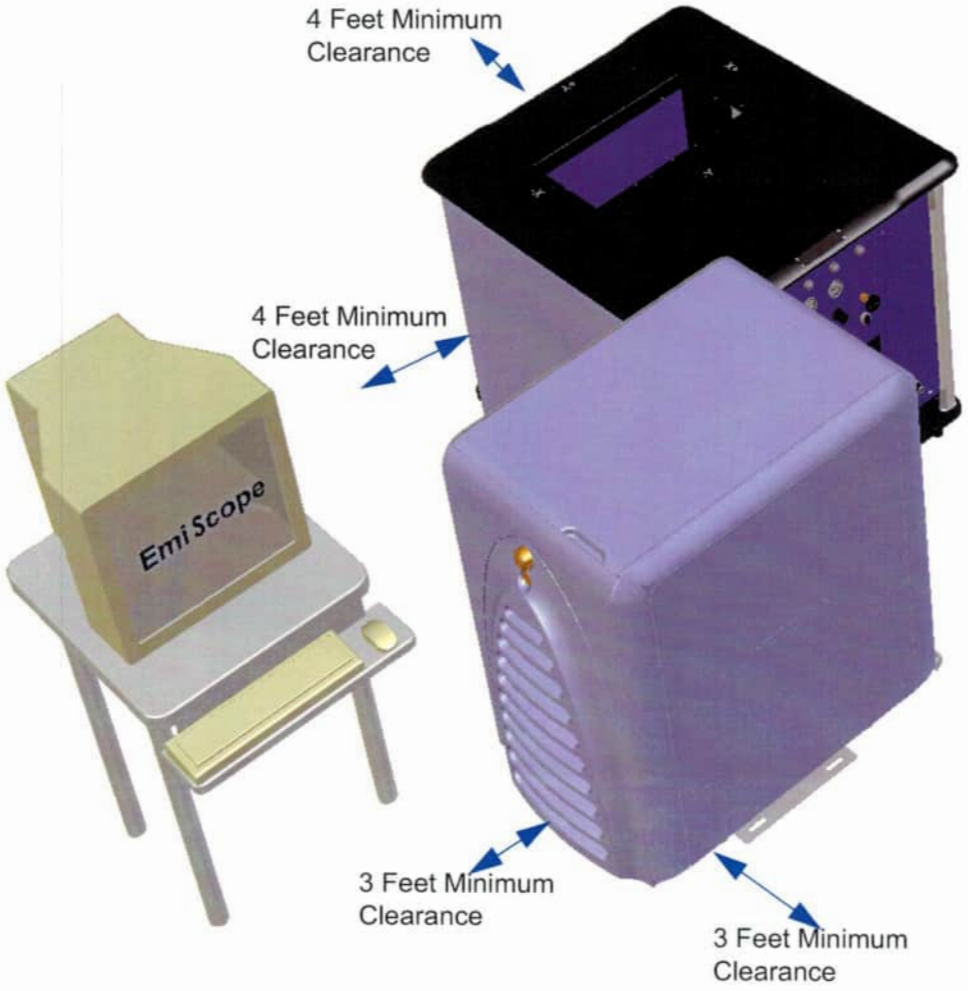
Danger	Description	Hazard prevention
Electrical energy	Hazardous voltages	All doors and enclosures sides are locked and require key for service access.
		Lock-out/tagout is available for all hazardous energy sources, including System Controller Box, Power Distribution Unit, and pneumatic supply.
		Non conductive or grounded conductive physical barriers are provided where failure of liquid fittings from any part of the equipment could result in the conduction of liquid into electrical parts.
		System interlocks shut off power to entire system except for PC.
Suspended weight	Pinch point	The EmiScope-II table top is supported by an air cylinder. When there is a total loss of system air pressure, the z-stage will not move. All doors and enclosures sides are locked and require key for service access.
Stored pressure	High pressure pneumatics	Pressure relief valves are provided by the regulators themselves, and relieve any pressure higher than 7 psi above the set value.
		Quick disconnect is provided at main air supply wall.
Hazardous moving parts	Pinch point	The EmiScope-II table top is supported by an air table. The hazardous area is enclosed within light box. Interlock switches on the light box panel de-energize the unit when the panel is removed. All doors and enclosures sides are locked and require key for service access.

Facility Requirements

Table 23 contains a list of the facilities requirements to install the EmiScope-II in a production mode. Credence recommends that:

1. This manual should accompany the EmiScope-II system at all times.
2. New owner assumes all liability if not consulting with factory.
3. Replacement of parts require prior Factory Consultation.
4. Management Information Systems (MIS) person is responsible for key access to PC.
5. Do not operate the EmiScope-II system when the facility supply of Clean Dry Air (CDA) exceeds 85 psi at the EmiScope-II pneumatic panel.

FIGURE 113. EmiScope-II Minimum Maintenance Access Clearances



9 Feet x 13 Feet Minimum Floor Space for EmiScope-II

FIGURE 114. EmiScope-II*t* Minimum Maintenance Access Clearances

9 Feet x 13 Feet Minimum Floor Space for EmiScope-II*t*

TABLE 23. Facility Requirements

Facility	Specification
System	9 ft. X 13 ft. minimum floor space for EmiScope-II.
	3 feet minimum clearance on sides and back of electronics rack for maintenance access.
	4 feet minimum clearance on sides and rear of optical table.
	Semi S-8 ergonomically approved space for customer supplied computer desk and chair.
	~3 ft. X 6 ft. without the computer desk and chair.
	Table for workstation and control panel console: 30" X 60" X 29" (W X L X H).
	Maximum connector (elephant trunk) length between workstation table and VIT is 6 feet.
Tester (ATE) interface	Built to match and dock to user-specific tester (i.e. Teradyne, Agilent, Schlumberger, IMS, etc.), test board, and space.
	Maximum vibration transmitted from the test board to the space transformer and measured at the DUT (i.e. using a SEM image): <30nm peak-to-peak amplitude.
	It is acknowledged that the specifications in this section apply to the requirements of a newly developed system. As such, all requirements are not clearly known and the listed specifications may not match the final requirements. Credence and the customer will collaborate to resolve any issues regarding the operating environment and the system to cure any problems that may arise during the installation, testing, and operation of the EmiScope-II.
Tester (ATE) trigger input	Input connector is 50Ω BNC.
	Allowable input voltage amplitude is +0.5V to +5V.
	Allowable DC offset is -2.5V to +2.5V.
	Trigger edge: positive or negative.
	Trigger circuit jitter within tester vendor's specifications.
	Rise/fall time is 5ns maximum recommended for reduced trigger jitter.
	Minimum Loop Length is 2µs.

TABLE 23. Facility Requirements (Continued)

Facility	Specification
Electrical	Power: 120VAC / 60Hz – 15A circuit with a NEMA L5-20R receptacle. Credence uses NEMA L5-20P.
Air Supply	
CDA for the vibration isolation table (VIT) and cavity	Pressure: 75-85 psi Consumption: 0.5 CFM @ 85 psi at system idle. 0.5 CFM @ 85 psi baseline operating condition. 1.0 CFM @ 85 psi average. 5 CFM @ 85 psi maximum during purge & DUT cooling.
CDA for condensation prevention (purge), stage drift control, and DUT cooling	Dry Air, 3 cu. ft. / min., ~25°C constant temperature. Inlet valve is 3/8in. urethane tubing connection with Push-Lok fitting. A customer provided desiccator is required for the CDA supply. The recommended desiccator is a Hankison International DHW Series as found on the Hankison International web page: http://www.hankisonintl.com/products/dhwseries.htm
Floor Vibration	It is recommended that the EmiScope-II be isolated from floor vibration. This is best done by ensuring that the tool is not in a raised floor environment, or, if the environment is raised, on an isolation pad. In any case, when the EmiScope-II is "soft" docked to a tester using a cable interface, vibrations of the device under test relative to the optical assembly are < 200nm peak to peak in all axes with under 75db acoustic noise across all frequencies.
Acoustic Vibration	Acoustic level not to exceed 75dB (C). It is acknowledged that the specifications in this section apply to the requirements of a newly developed system. As such, all requirements are not clearly known and the listed specifications may not match the final requirements. Credence and the customer will collaborate to resolve any issues regarding the operating environment and the system to cure any problems that may arise during the installation, testing, and operation of the EmiScope-II.

TABLE 23. Facility Requirements (Continued)

Facility	Specification
Temperature	Operating Temperature: Constant 15° to 30°C with temperature swings of ˜5°C. Storage temperature range: 10° to 40°C. It is acknowledged that the specifications in this section apply to the requirements of a newly developed system. As such, all requirements are not clearly known and the listed specifications may not match the final requirements. Credence and the customer will collaborate to resolve any issues regarding the operating environment and the system to cure any problems that may arise during the installation, testing, and operation of the EmiScope-II.
Lighting	No infrared emitting illumination (e.g. no halogen or outdoor lighting). It is acknowledged that the specifications in this section apply to the requirements of a newly developed system. As such, all requirements are not clearly known and the listed specifications may not match the final requirements. Credence and the customer will collaborate to resolve any issues regarding the operating environment and the system to cure any problems that may arise during the installation, testing, and operation of the EmiScope-II.

Please reference the following SEMI Standards:
SEMI E6-96, SEMI Facility Interface Specifications Format
SEMI E78 Level III Electromagnetic interference

Energy Consumption

The energy consumption for EmiScope-II measured at Peak, Idle and Average are:

- Peak Current at startup is <15 Amps.
- Idle Current during most common operating conditions, is <10 Amps.
- Average during most common conditions is <10 Amps.

Seismic

- **EmiScope-II Electronics Rack Seismic Brackets**

The design and analysis of the Electronics Rack Seismic Brackets is based on Semi S2-0703: Environmental, Health, and Safety Guideline for Semiconductor Manufacturing Equipment Document; Section 19.2.2: Seismic Protection.

The EmiScope-II end user is responsible for proper tie-down of the EmiScope-II Electronics Rack at the user's facility. Each of the four holes in the seismic brackets should be used with Grade-2, or better, 0.5 inch diameter hardware. The anchoring system to the facility should be able to withstand a minimum of 500 lbs. pull-up and 100 lbs. lateral load at each of the four mounting locations.

The EmiScope-II*t* end user is responsible for proper tie-down of the EmiScope-II*t* Electronics Rack at the user's facility. Each of the four holes in the seismic brackets should be used with Grade-5, or better, 0.5 inch diameter hardware. The anchoring system to the facility should be able to withstand a minimum of 1500 lbs. pull-up and 400 lbs. shear force at each of the four mounting locations.

For EmiScope-II, Figure 115 defines the electronics rack individual components and component weights. Figure 116 summarizes the electronics rack components into a single center of gravity location. Figure 117 summarizes the resultant forces applied to each seismic bracket mounting location. Figure 118 describes the FEA stress calculations for the seismic bracket loading, front view. Figure 119 describes the FEA stress calculations for the seismic bracket loading, side view.

For EmiScope-II*t*, Figure 120 defines the electronics rack weight and center of gravity. Figure 121 summarizes the electronics rack components' center of gravity locations. Figure 122 summarizes the summarizes the resultant forces applied to each seismic bracket mounting location. Figure 123 describes the FEA stress calculations for the seismic bracket loading in compression. Figure 124 describes the FEA stress calculations for the seismic bracket loading in tension.

For EmiScope-II, The worst case loading to the electronics rack seismic bracket occurs as depicted in the side view. FEA analysis of the bracket shows the maximum stress is expected to be approximately 16,000 psi resulting in a safety factor of 1.8 (assuming 30 ksi material yield). The alternate loading direction, front view, shows FEA analysis withe the maximum stress expected on the bracket to be approximately 12,400 psi resulting in a

safety factor of 2.4 (assuming 30ksi material yield). The worst case loading to the 0.5 inch hardware required to mount the seismic bracket to the facility results in approximately 3000 psi stress to the bolt. Using Grade-2 or better hardware will result in a safety factor of at least 20 (assuming 60 ksi yield for Grade-2).

For EmiScope-II*t*, the worst case loading to the electronics rack seismic bracket occurs as depicted when the seismic bracket is in tension. FEA analysis of the bracket shows the maximum stress is expected to be approximately 23,000 psi resulting in a safety factor of 1.4. The alternate loading direction, compression view, shows FEA analysis withe the maximum stress expected on the bracket to be approximately 10,300 psi resulting in a safety factor of 3.1. The worst case loading to the 0.5 inch hardware required to mount the seismic bracket to the facility results in approximately 11057 psi stress to the bolt. Using Grade-5 or better hardware will result in a safety factor of at least 9.

FIGURE 115. EmiScope-II Electronics Rack Heights, Weights, and Seismic Hold Down

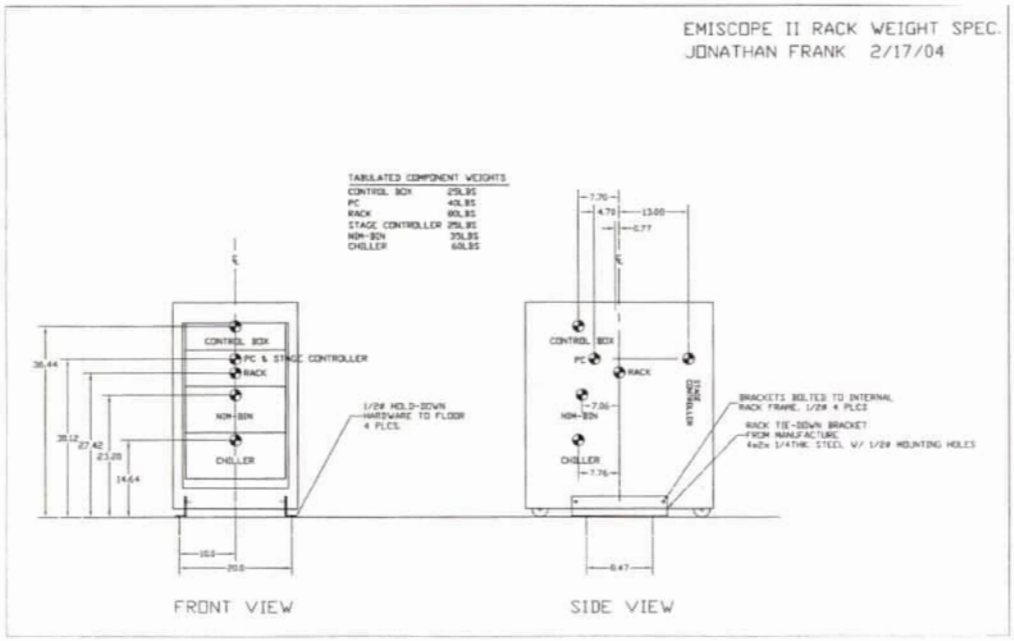


FIGURE 116. EmiScope-II Electronics Rack Center of Gravity

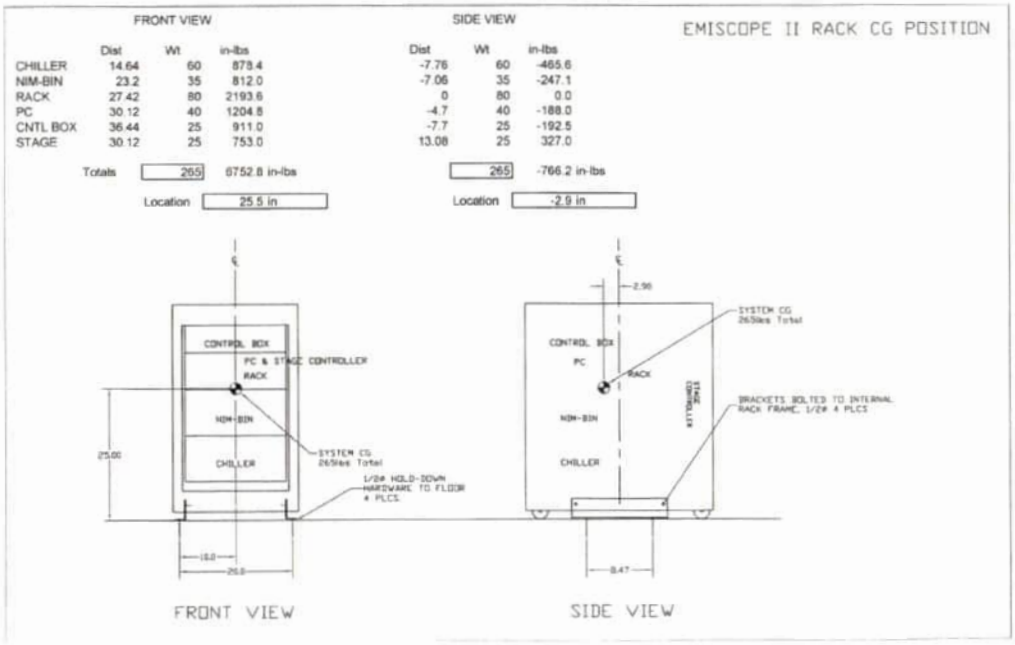


FIGURE 117. EmiScope-II Electronics Rack Seismic Mounting Locations Forces

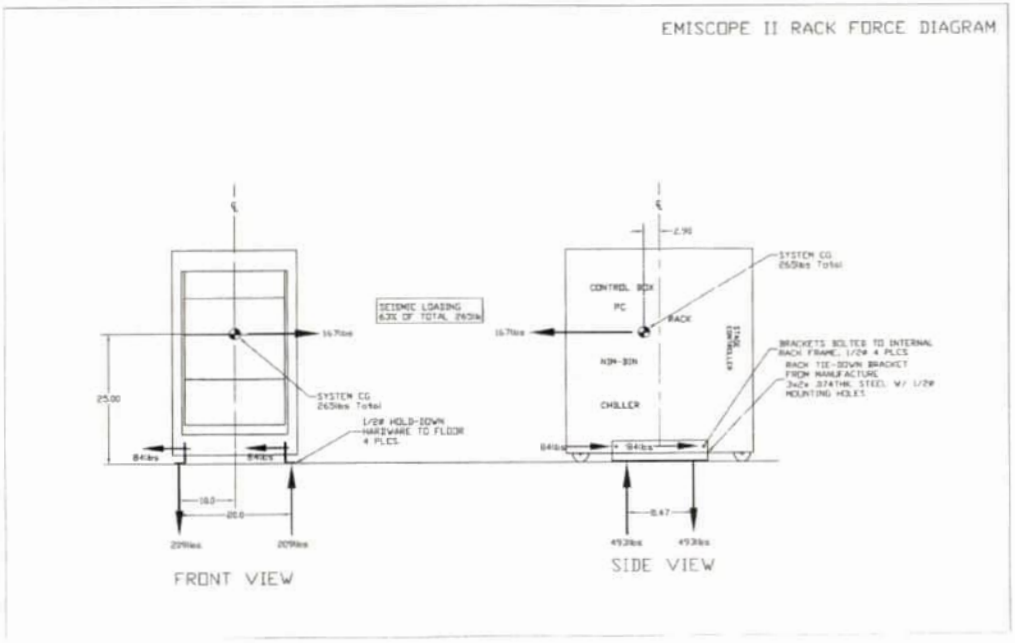


FIGURE 118. EmiScope-II Electronics Rack Seismic Bracket Stress, Loading in Front View

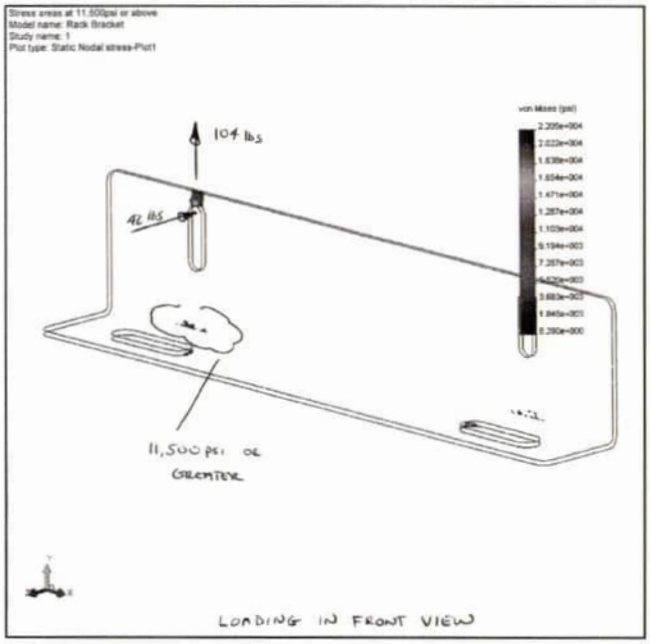


FIGURE 119. EmiScope-II Electronics Rack Seismic Bracket Stress, Loading in Side View

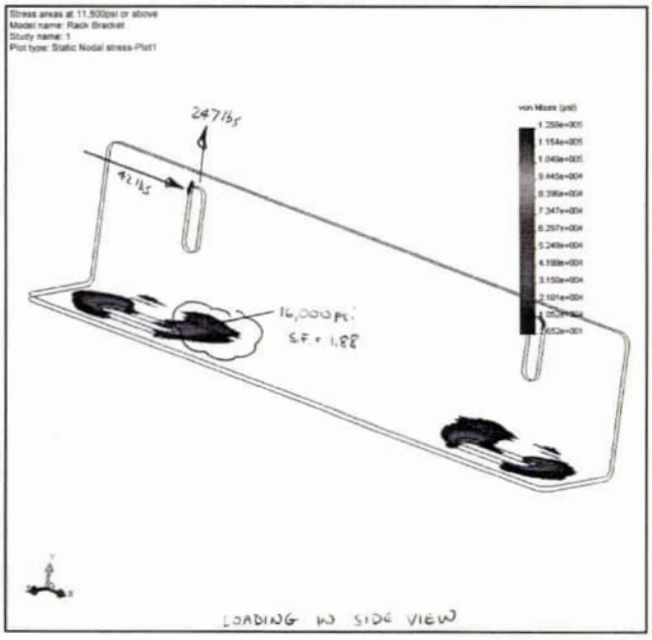


FIGURE 120. EmiScope-II*t* Electronics Rack Weight and Center of Gravity

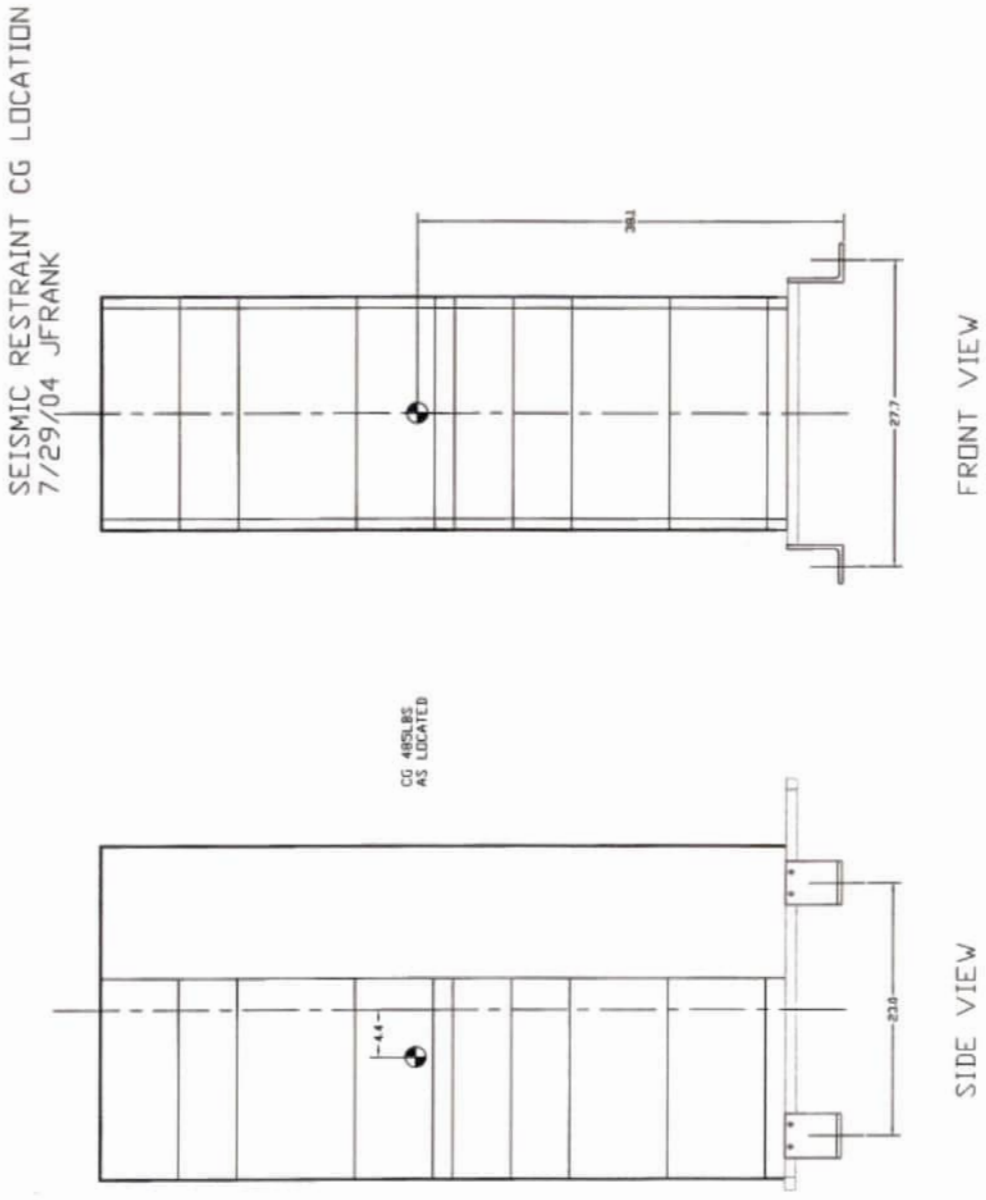


FIGURE 121. EmiScope-II*t* Electronics Rack Components Center of Gravity

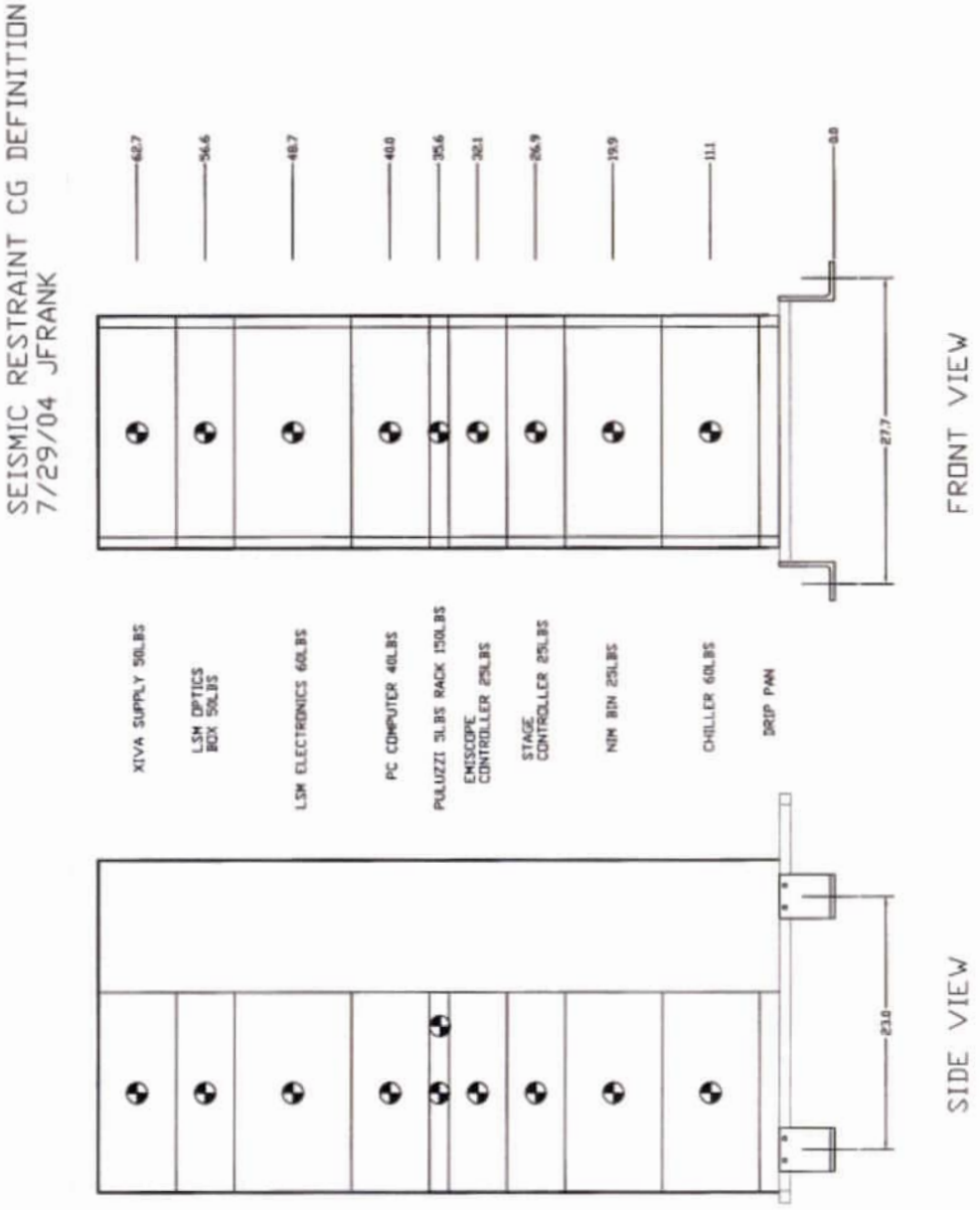


FIGURE 122. EmiScope-II*t* Electronics Rack Seismic Mounting Locations Forces

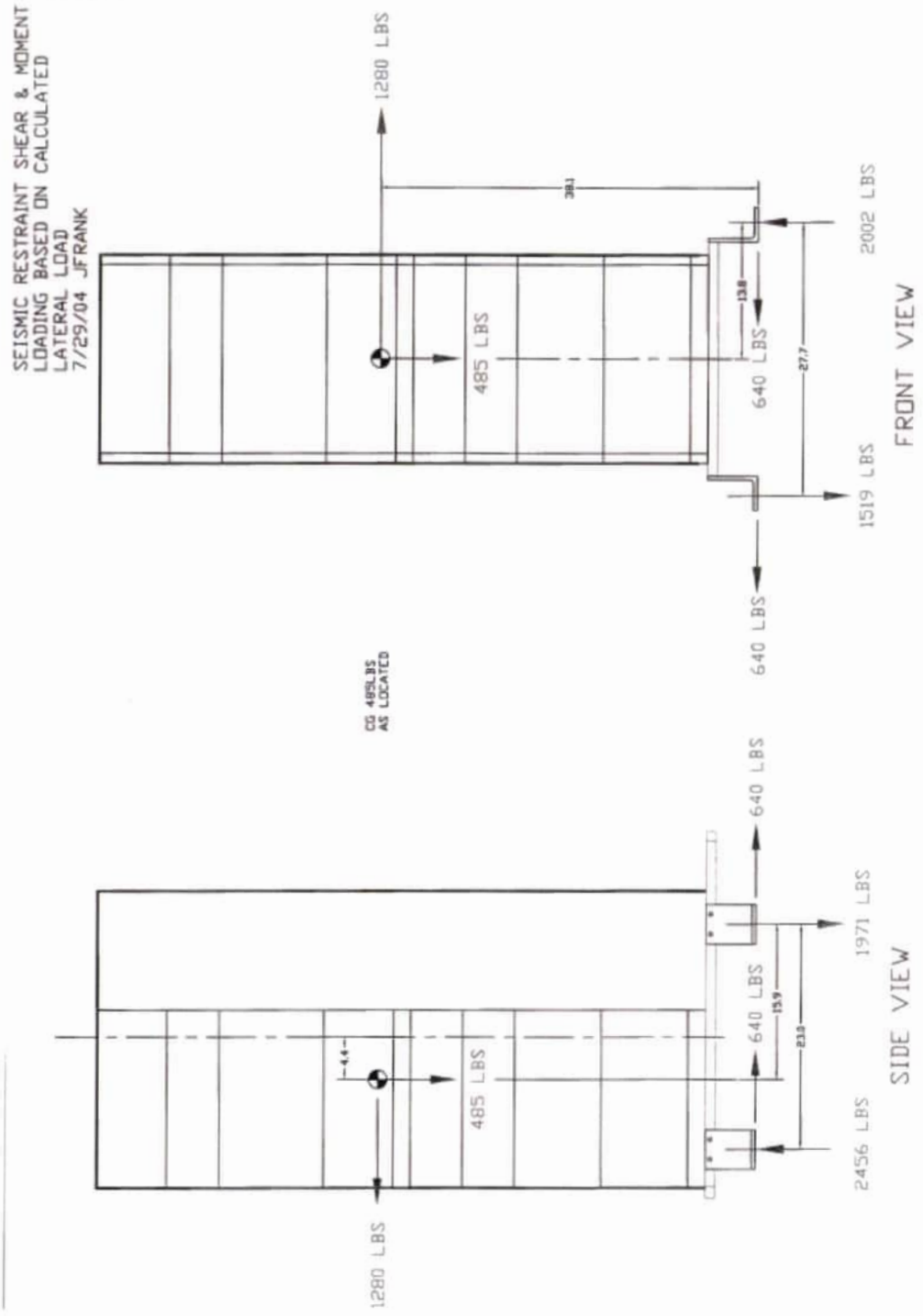


FIGURE 123. EmiScope-II*t* Electronics Rack Seismic Bracket Stress, Loading in Compression

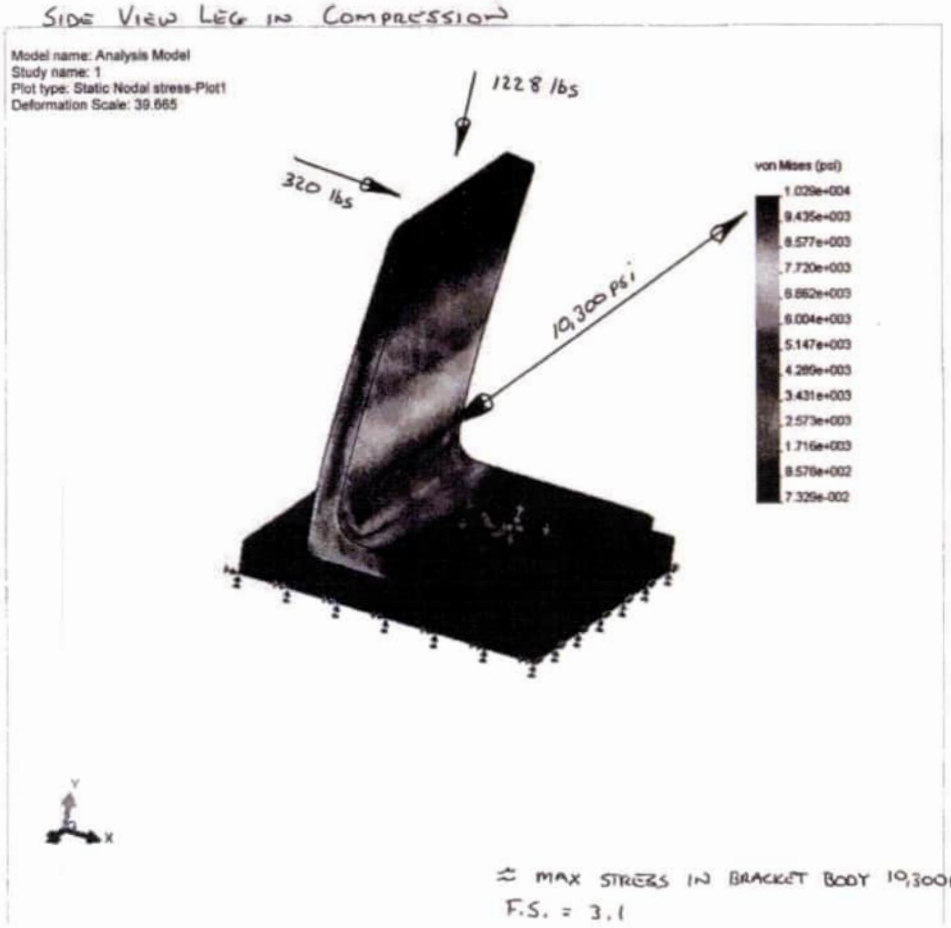


FIGURE 124. EmiScope-II*t* Electronics RAck Seismic Bracket Stress, Loading in Tension

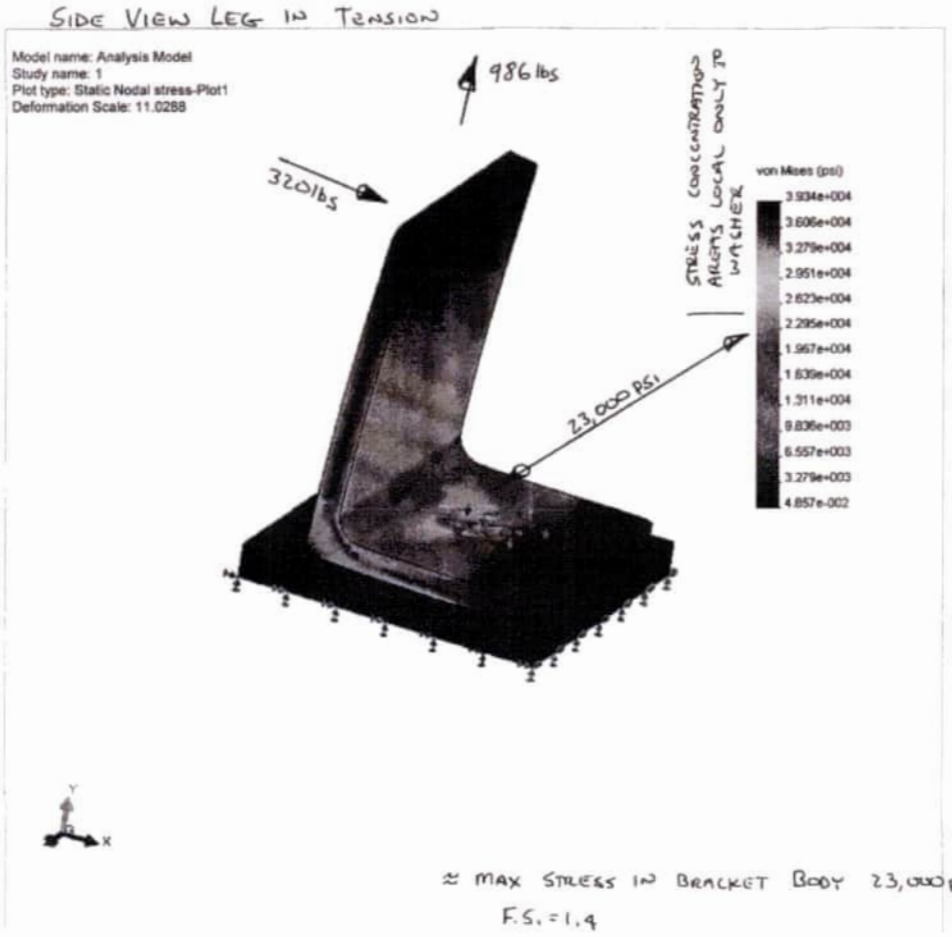
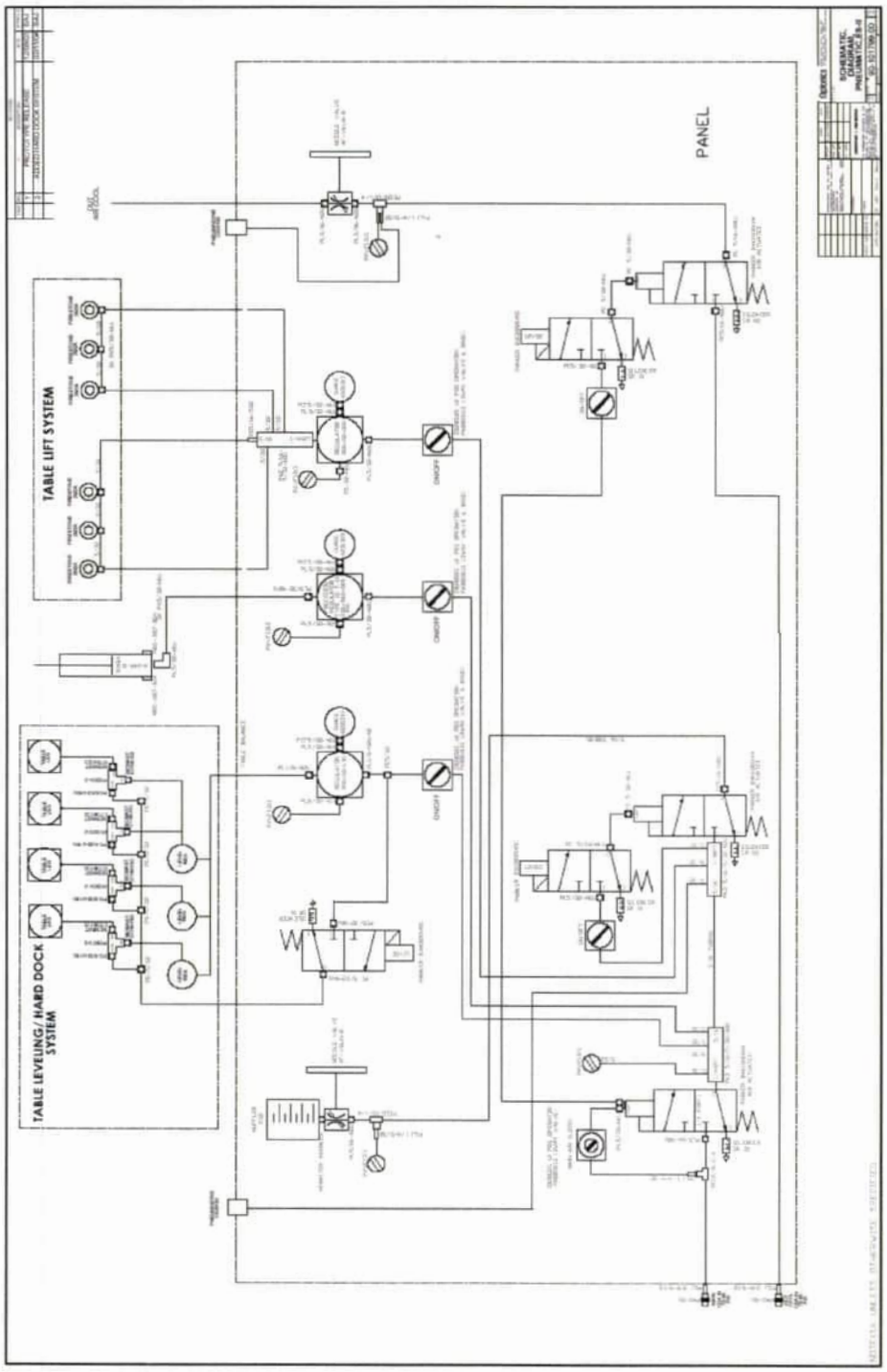


Figure 115 - Figure 124 show the equipment, support equipment, CDA connections and anchorage location. They include the physical dimensions, including width, length, and height of each structurally independent module, the type of feet used and their location, the weight distribution on each foot, the weight and location of the center of mass for each module, and the acceptable locations on the equipment frame for anchorage.

FIGURE 125. EmiScope-II Pneumatic Panel Schematic



Installation

The EmiScope-II is designed to withstand a temperature of range of -13 to 131 degrees Fahrenheit during transportation and storage and up to 149 degrees Fahrenheit for period not to exceed 24 hours.

The EmiScope-II is shipped in five crates. System installation is performed by Credence personnel only.

1. Do not stack the shipping crates. Stacking crates can damage the equipment.
2. Do not open the shipping crates without the Credence installation personnel present.

Maintenance and Service

The EmiScope-II is composed of subsystem modules and replaceable devices. System service is performed on-site by the removal and replacement of the failing subsystem or device. All service and maintenance for the EmiScope-II should be performed by a trained Credence personnel. There are no user serviceable subsystems, modules, or devices in the EmiScope-II.

System service requires that the system power be locked out. The system is disconnected at the main power and pneumatic input by lockout tagout devices. For additional information relating to the safe operation of the EmiScope-II, please refer to "Safety" on page 7.

WARNING: Verify that the EmiScope-II is de energized before performing maintenance or service. Please refer to the procedure in Chapter 2, "Safety", "Hazardous Energy Isolation" on page 24. It describes how to verify that the system is de-energized.

EmiScope-II maintenance and service does not require any hazardous or toxic substances that would result in secondary contamination of the environment or sub-systems, modules, or devices. All replaced subsystems are returned to Credence for proper disposal, repair, or return to manufacturer. Replaceable devices are returned to Credence for proper disposal with the exception of the steam-distilled water. If it is necessary to drain the process

water chiller tank, the contents, 64 ounces of steam distiller water, can be disposed of through a common sewer system.

EmiScope-II Diagnostics

The EmiScope-II software application has built-in self test(BIST) to verify several basic system functions, see Figure 126 on page 212. The system functions that can be verified are:

- Illuminator and sub-functions
- Detector and sub-functions
- Flippers and sub-functions
- System Health

In order to fully utilize the EmiScope-II diagnostics, the following diagnostic hardware is required: a trigger stimulus source and a sample plate with calibration target. The diagnostic hardware is optional system hardware and may not be included on all EmiScope-II systems. Contact Credence technical support for more information. Alternatively, user supplied imaging and trigger sources can be supplied for use with the diagnostics. However, in order to make the diagnostics supply useful feedback, the same imaging and trigger sources must be used every time the diagnostics are performed.

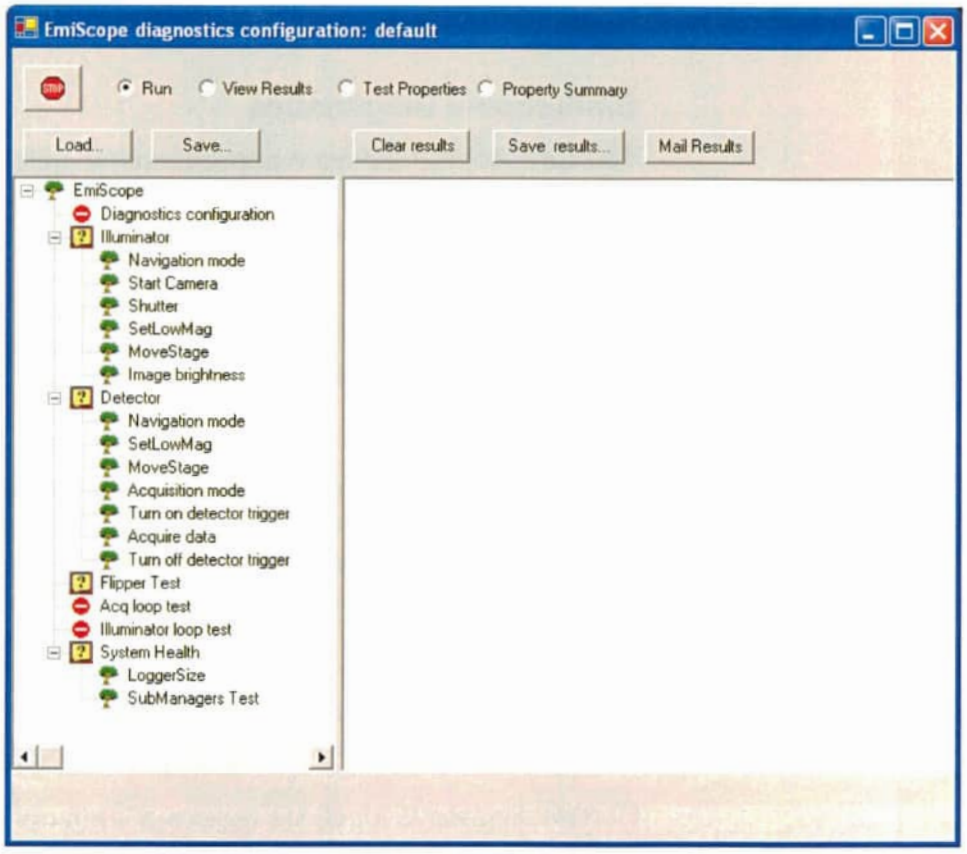
Certain diagnostic functions require a learn operation for the diagnostics to be properly calibrated. After the learn operation, subsequent diagnostic runs will be measured against the learned responses in order to report a pass or fail condition.

Note: The EmiScope-II Diagnostics are controlled by Superuser access. See "Superuser Functions" on page 49.

♦ **To perform the EmiScope-II Diagnostics,**

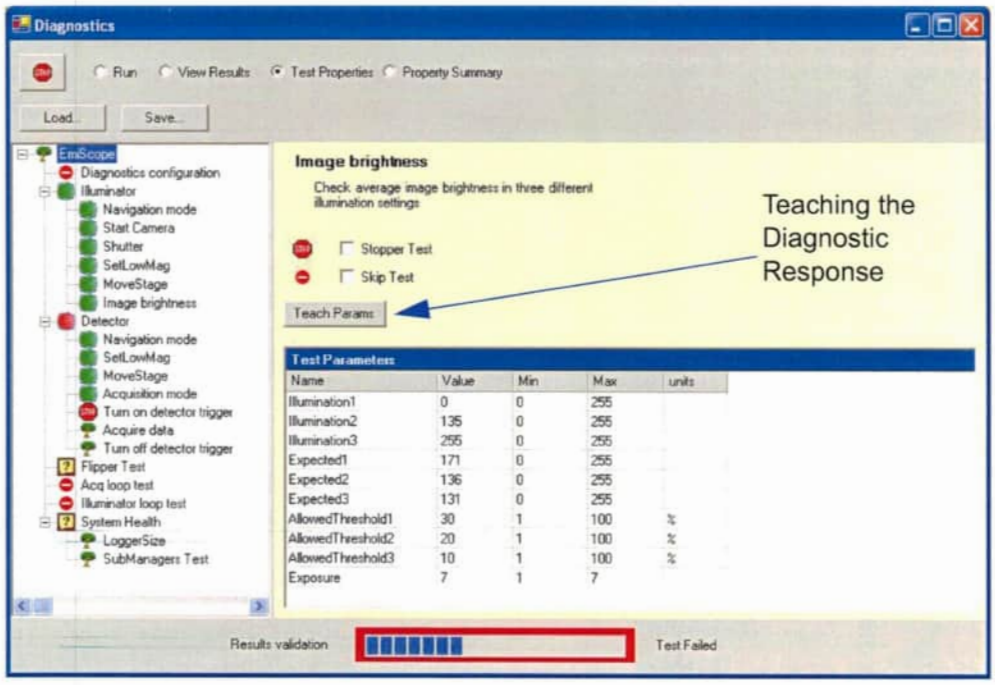
1. Logon as Superuser.
2. Dock the diagnostic hardware sample plate onto the EmiScope table top. Connect the diagnostic hardware trigger stimulus source to the trigger input of the EmiScope, see "Acquiring a Histogram" on page 142.
3. In the Navigation mode main menu, select Diagnostics and the Diagnostics Application will open, see Figure 126.

FIGURE 126. EmiScope Diagnostics Application



4. For the diagnostics to be properly calibrated the following tests require a learn operation: Move Stage, Image Brightness, Turn on Detector Trigger, Acquire Data, Turn off Detector Trigger. To teach the diagnostic responses for theses functions, select the Test Properties button at the top of the Diagnostic Application, then select one of the functions that require a learned response, for example Image Brightness, see Figure 127. Select the Teach Params button. The application will perform the diagnostic selected, and record(learn) the appropriate response. This learning function should be performed for each of the functions listed above.

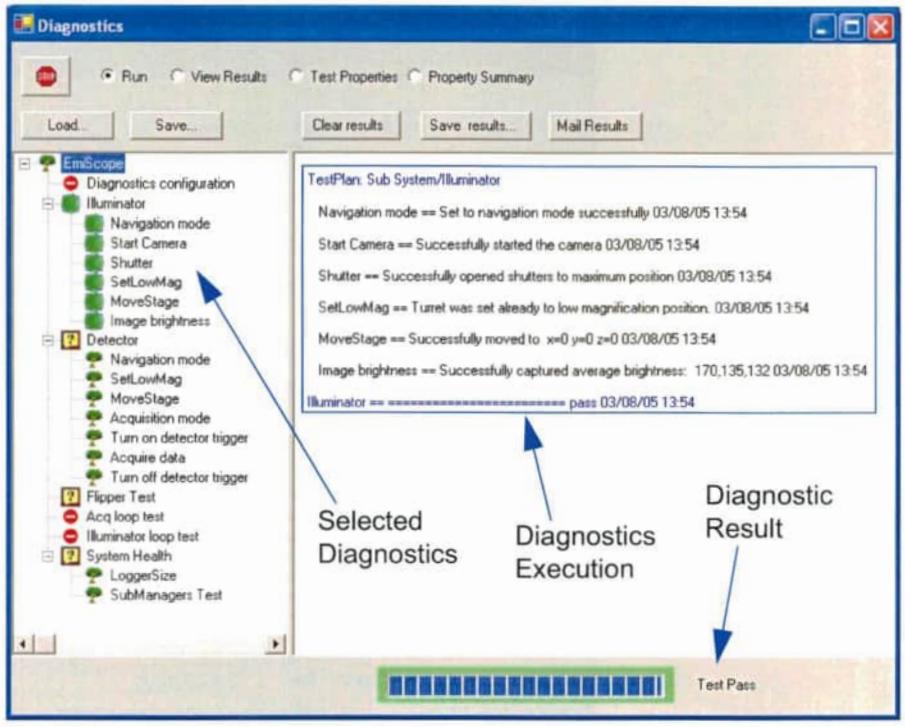
FIGURE 127. Diagnostic Application Learning



5. To perform a diagnostic, select the Run button at the top of the Diagnostic Application window, then click on a function, for example, Illuminator. The diagnostics will execute and report a pass or fail condition. See Figure 128.

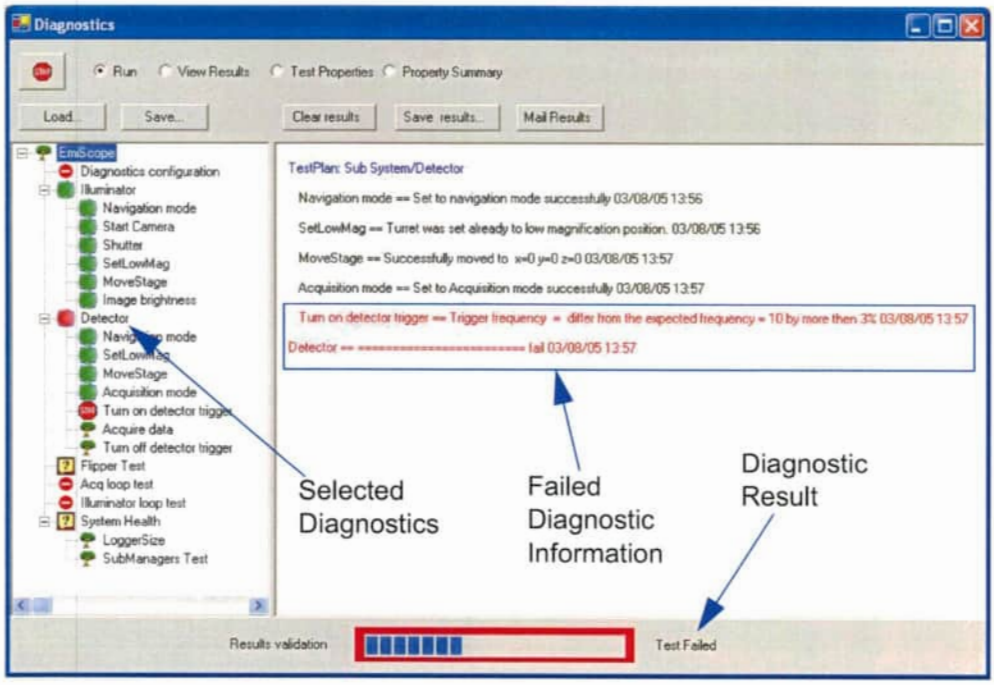
Note: If a diagnostic response requires learning and the learning operation has not been performed, the diagnostic execution result will not be valid.

FIGURE 128. Diagnostic Application Execution and Pass Result



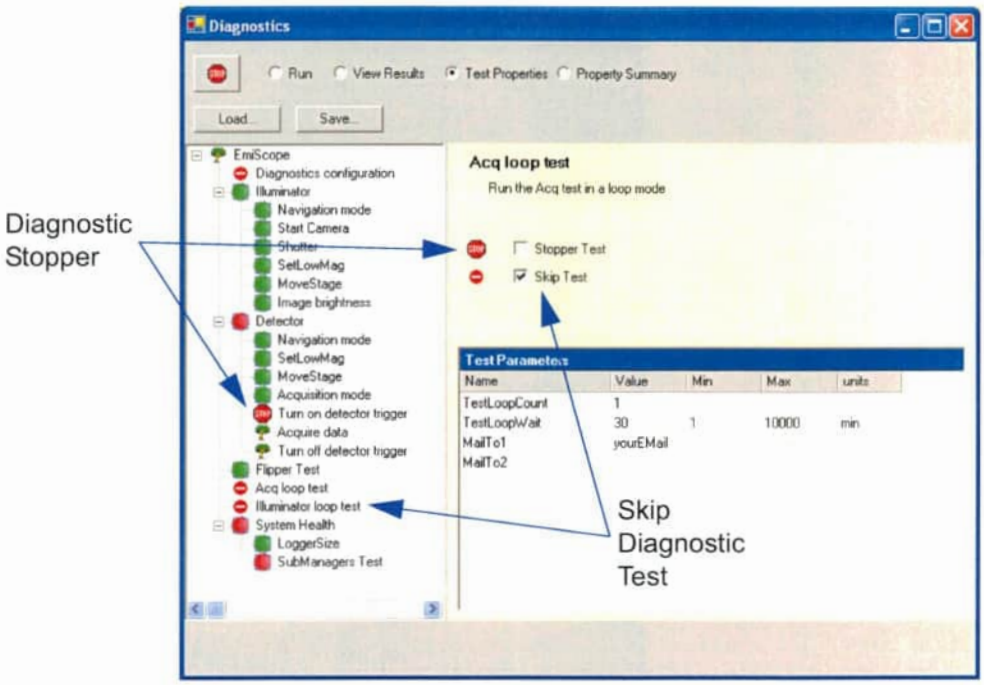
6. If a diagnostic execution results in a fail condition, the failed function icons will be displayed in red, and the diagnostic results can be viewed by clicking on the View Results button, then clicking on the desired function. See Figure 129.

FIGURE 129. Diagnostic Application View Results



7. The diagnostic functions to be executed can be customized. Select the Test Properties button then select a desired function. The diagnostic test for the selected function can be skipped by selecting the Skip Test check box. Any diagnostic that is designated to be skipped will have a distinctive icon. The diagnostic test for the selected function can be designated as the stopping point for the diagnostic execution by selecting the Stopper Test check box. If a function is selected to be a Stopper Test, the diagnostics will stop at the designated function if the test result for the function returns a fail condition. Any diagnostic designated as a stopper will have a distinctive icon. See Figure 130.

FIGURE 130. Diagnostic Application Customization

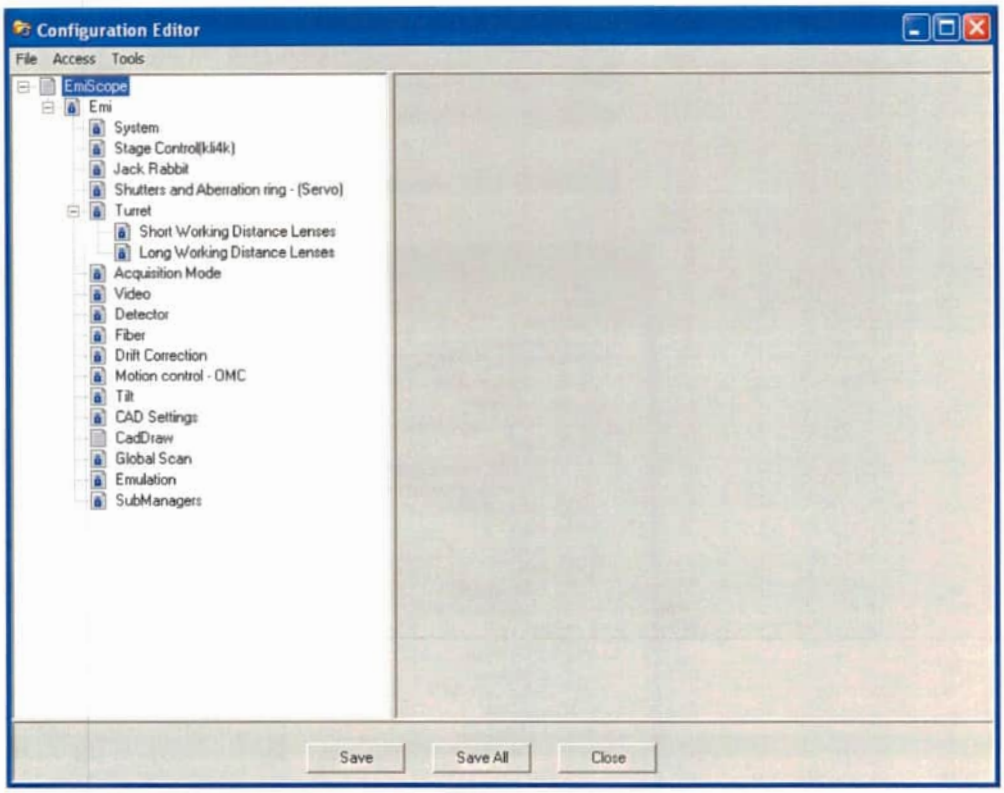


8. The results of the diagnostic tests can be sent via e-mail to a user designated address by selecting the Mail Results button and entering a valid e-mail address.

Configuration Tool

The EmiScope software Configuration Tool is used to define critical system parameters and to perform certain system calibrations. All of the functions in Configuration Tool are controlled by Superuser access and/or Credence Support access. See Figure 131.

FIGURE 131. Configuration Tool



Note: All of the functions in Configuration Tool are controlled by Superuser access. See "Superuser Functions" on page 49.

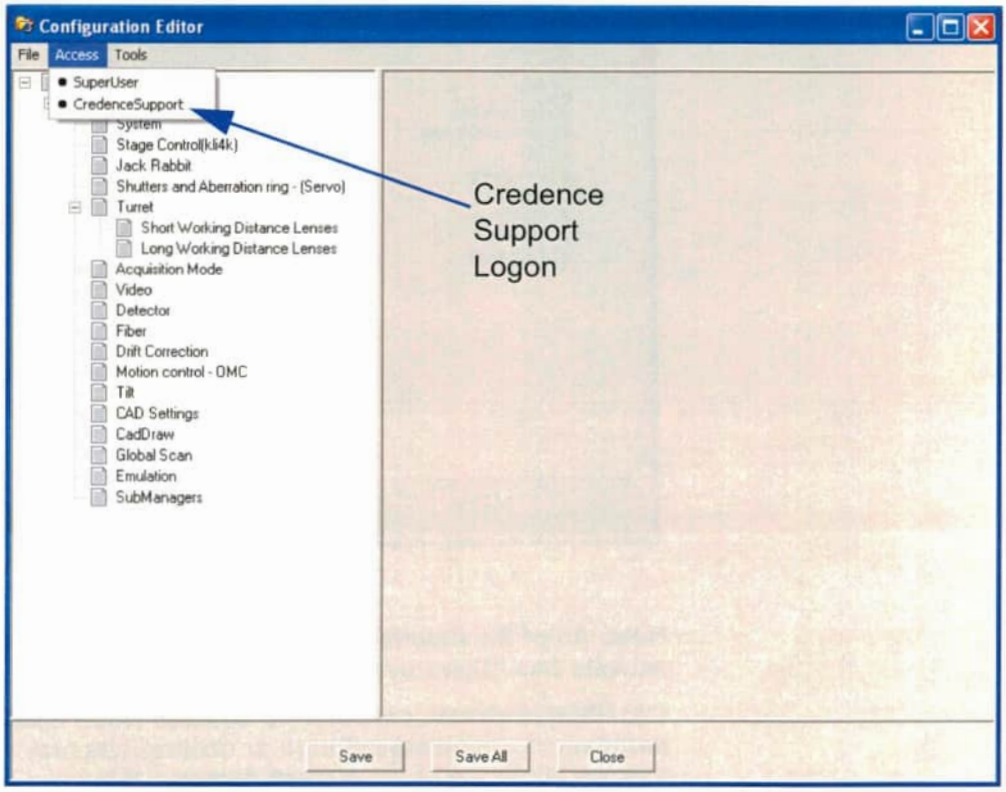
CAUTION: Extreme care should be used when altering any Configuration Tool parameters. Incorrect settings or calibrations may cause unpredictable system response or equipment damage. If system parameters are to be changed and you are uncertain of how to proceed, contact Credence Support prior to making any changes.

Configuration Tool, Credence Support Functions

- Note: Certain functions of the EmiScope-II software are protected by a second level of password. Access to these functions require entering the correct Superuser password, and then entering the correct Credence Support password. Credence Support functions are noted when used in this manual.

- To access Credence Support functions, first logon as Superuser. See "Superuser Functions" on page 49. In Configuration Tool, select Credence Support from the Access menu. See Figure 132. When the correct password is entered, the Credence Support functions are enabled. See your EmiScope-II system administrator for Credence Support access, or contact Credence technical support.

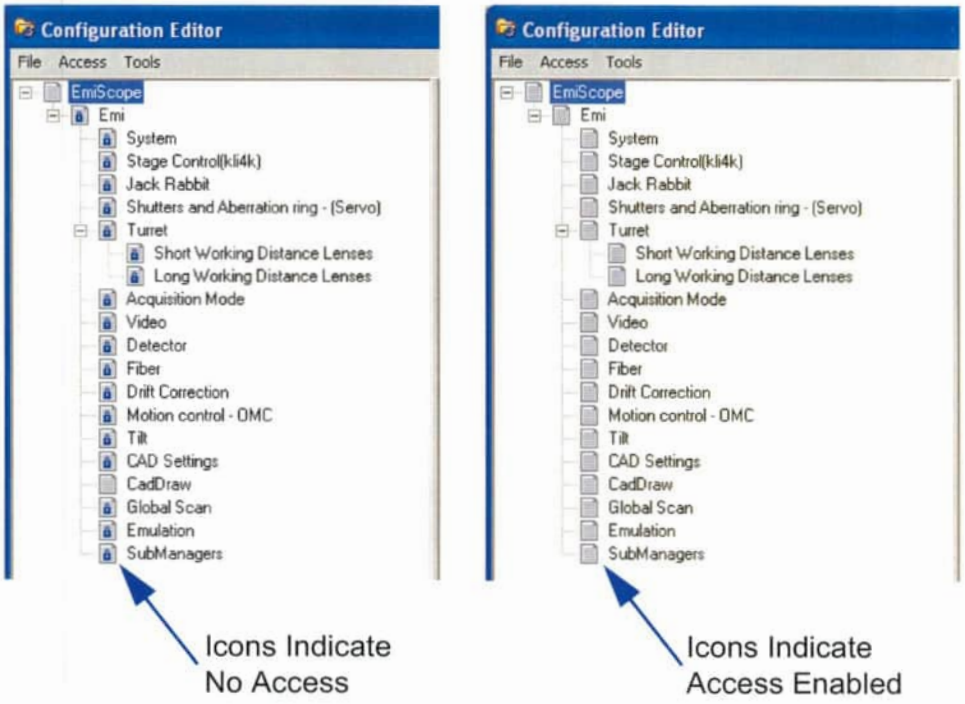
FIGURE 132. Accessing Credence Support Functions



Configuration Tool Functions

The appearance of the Configuration Tool icons will change once Superuser access is enabled. The icon appearance is a useful guide to indicate that access to the Configuration Tool functions is enabled. See Figure 133.

FIGURE 133. Configuration Tool Icon Appearance



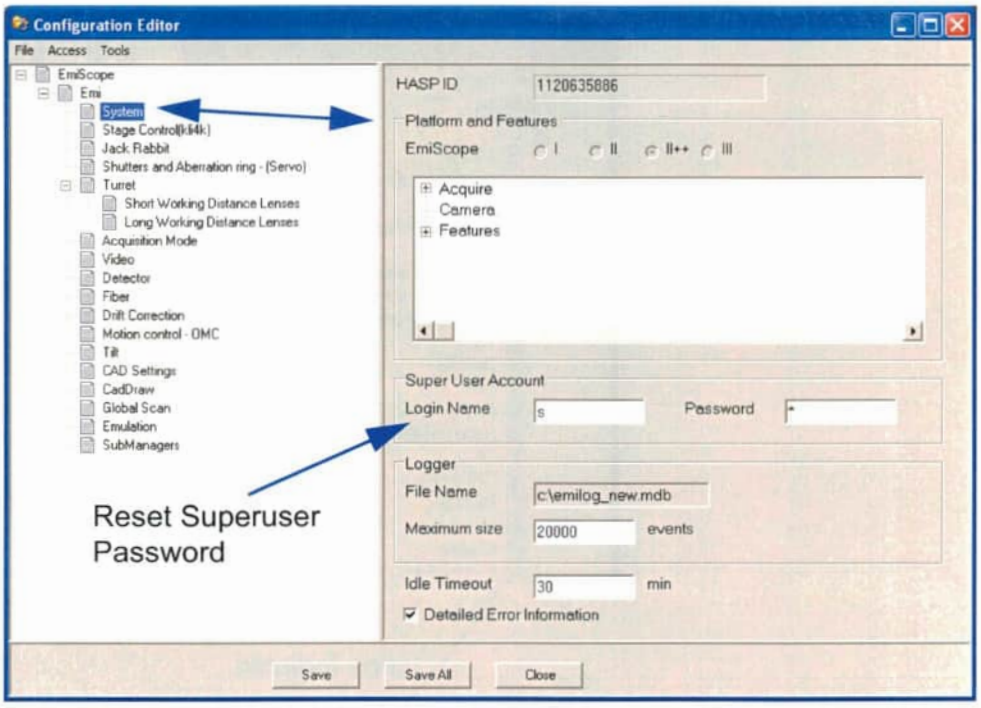
Configuration Tool Control Panels

To access Configuration Tool control panels, select the icon of interest in the Configuration Tool main window, and the appropriate control panel will be displayed. Access to certain functions requires enabling Superuser and/or Credence Support.

1. System control panel (See Figure 134):
   The System control panel displays the EmiScope-II system platform type and software options that are enabled. You can use this panel to reset the Superuser password, define the log file name and location for software logging information (see Chapter 8, “Event Logs”), and define the EmiScope software application idle time.

Note: The EmiScope-II platform type and software options cannot be altered. For more information, contact Credence technical support.

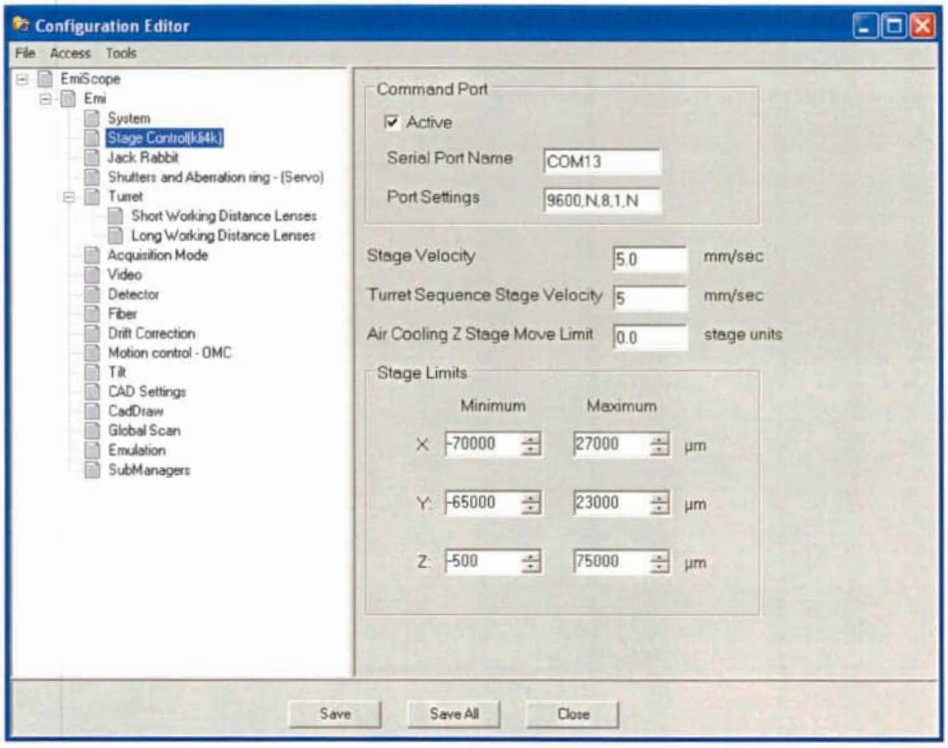
FIGURE 134. Configuration Tool System Panel



2. Stage Control control panel (See Figure 135):
   The Stage Control control panel is used to define the communication with the XYZ stages and set the stages limits and velocities.

Note: Use extreme care if altering Stage Control parameters. Incorrect settings may cause unpredictable system response or equipment damage. For more information, contact Credence technical support.

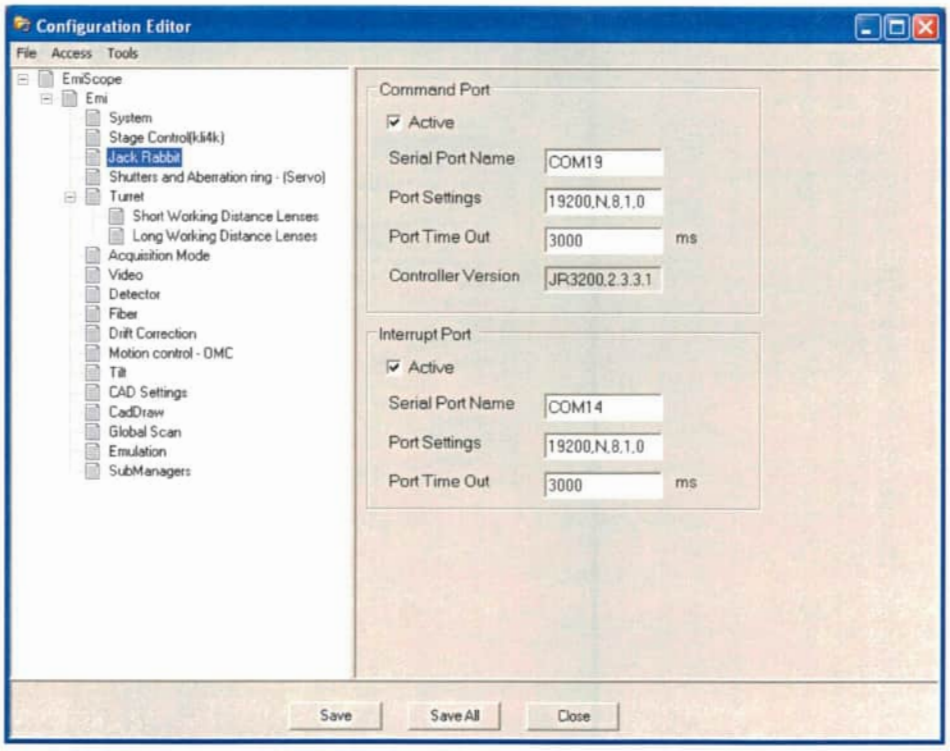
FIGURE 135. Configuration Tool Stage Control Panel



3. Jack Rabbit control panel (See Figure 136):
   The Jack Rabbit control panel is used to define the communication with the main EmiScope-II system controller.

Note: Jack Rabbit controls should only be altered by qualified Credence support personnel. Incorrect settings may cause unpredictable system response or equipment damage. For more information, contact Credence technical support.

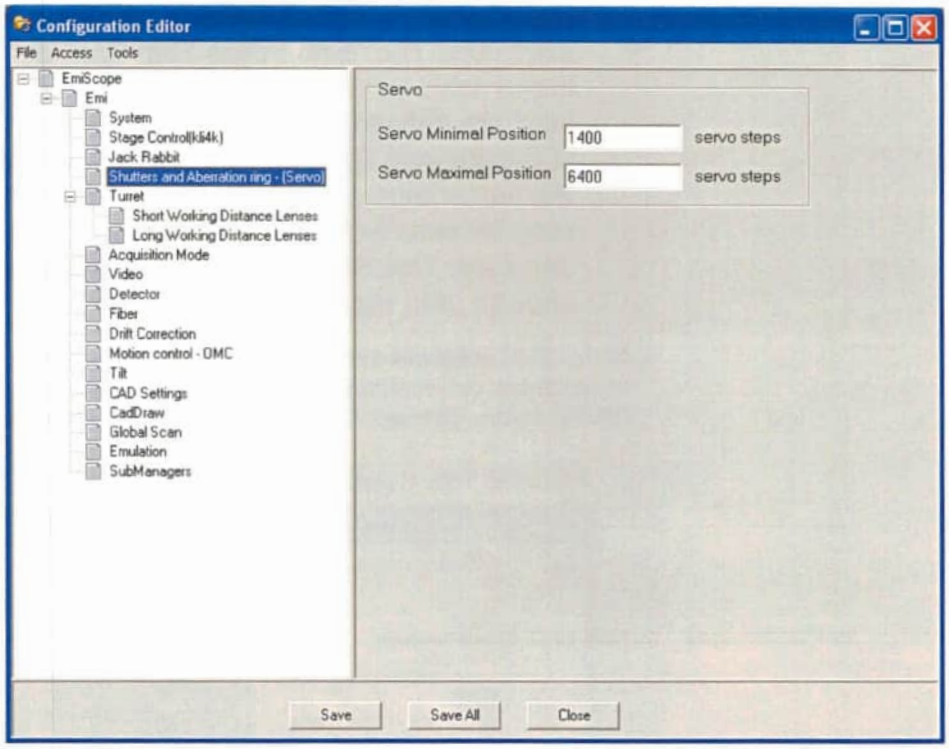
FIGURE 136. Configuration Tool Jack Rabbit Control Panel



4. Shutters and Aberration ring control panel (See Figure 137):
   The Shutters and Aberration ring control panel is used to define the limits of the EmiScope-II system servos.

Note: Shutters and Aberration ring controls should only be altered by qualified Credence support personnel. Incorrect settings may cause unpredictable system response or equipment damage. For more information, contact Credence technical support.

FIGURE 137. Configuration Tool Shutters and Aberration ring Control Panel



5. Turret control panel:
   The Turret control panel is used to define the current lenses installed in the EmiScope-II system and to define the lens parameters. The Turret control is comprised of a main control panel and two nested panels. The main Turret control panel, see Figure 138, defines the tolerances for 'SIL landing sensor'. The default values should not be altered. The Short Working Distance Lenses nested control panel, see Figure 139, defines the global parameters for all short working distance lenses. The 'Socket #'defines the physical turret socket location for each lens. The 'Auto Focus Step Size' defines the default stage increments used for the Navigation mode Auto Focus routine. The 'Lens Offsets' are defined by the Lens Offset Wizard in the Tools menu, see "Configuration Tool Menu Functions" on page 238. The 'SIL Blind Ascend' value defines the percentage of stage travel that occurs when switching from low magnification to the SIL before the SIL landing routine is engaged. The 'SIL Travel Range' defines the amount of stage travel allowed after the SIL is landed.

The Long Working Distance Lenses nested control panel, see Figure 140, defines the global parameters for all long working distance lenses. The 'Socket #' defines the physical turret socket location for each lens. The 'Auto Focus Step Size' defines the default stage increments used for the Navigation mode Auto Focus routine. The 'Lens Offsets' are defined by the Lens Offset Wizard in the Tools menu, see "Configuration Tool" on page 216. The 'SIL Blind Ascend' value defines the percentage of stage travel that occurs when switching from low magnification to the LWD-SIL before the LWD-SIL landing routine is engaged. The 'SIL Travel Range' defines the amount of stage travel allowed after the LWD-SIL is landed.

Note: Use extreme care if altering Turret control parameters. Incorrect settings may cause unpredictable system response or equipment damage. For more information, contact Credence technical support.

FIGURE 138. Configuration Tool Main Turret Control Panel

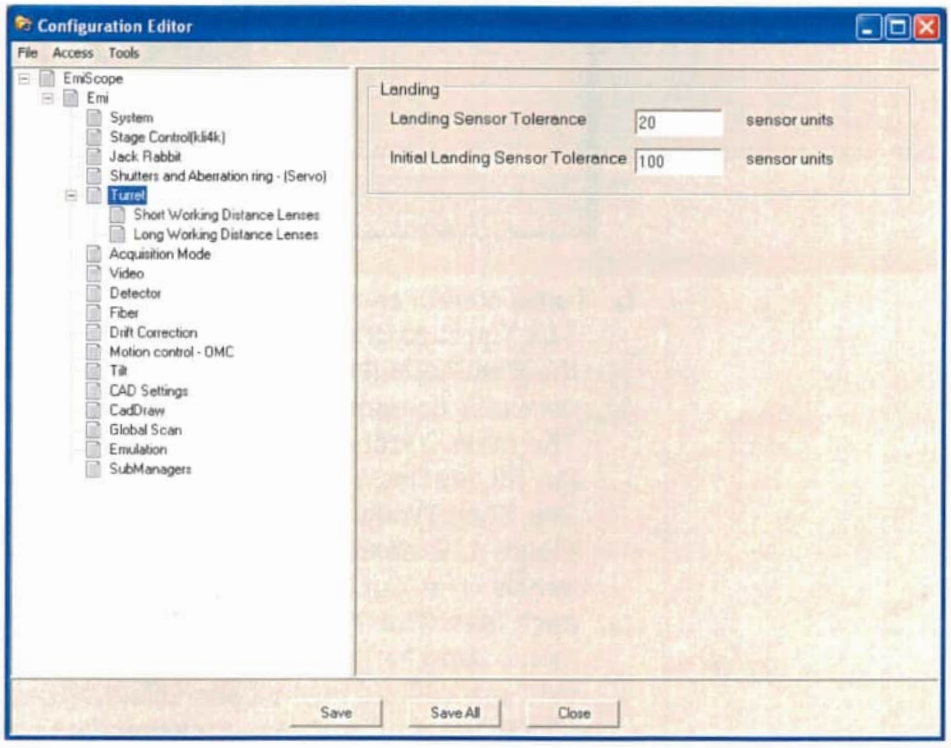


FIGURE 139. Configuration Tool Short Working Distance Lenses Control Panel

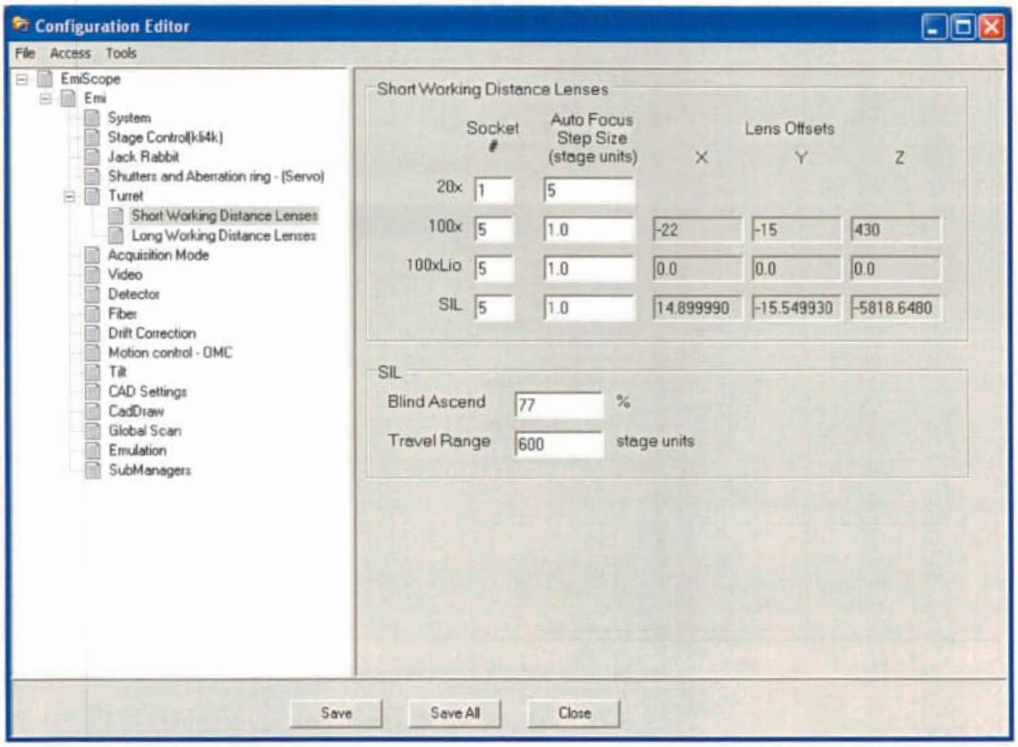
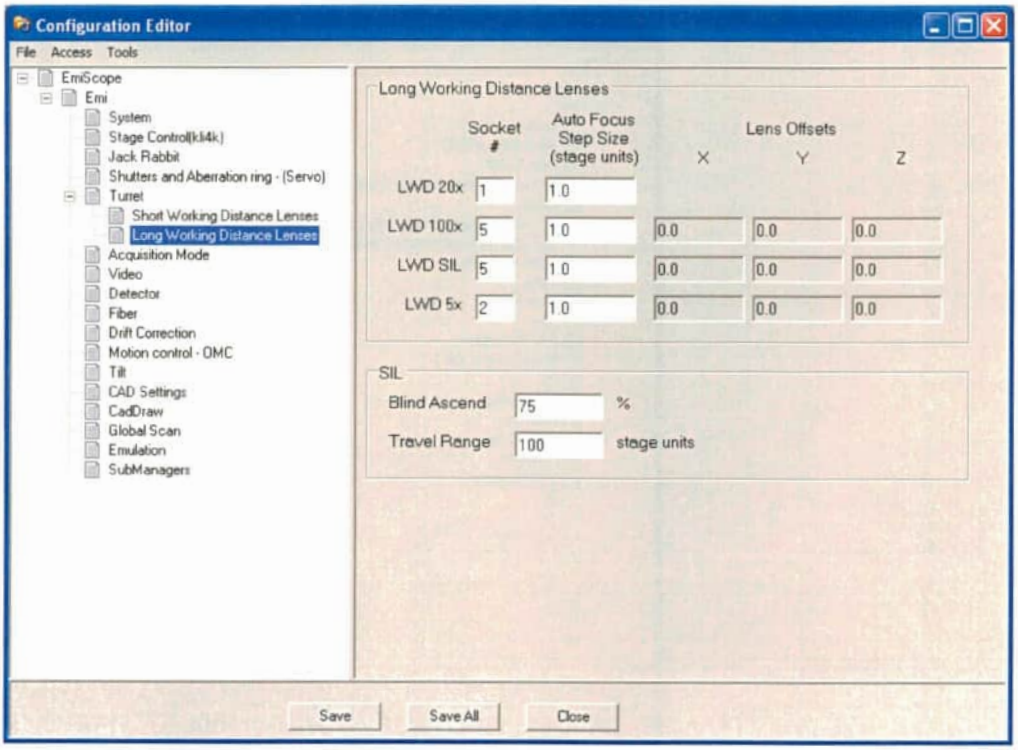


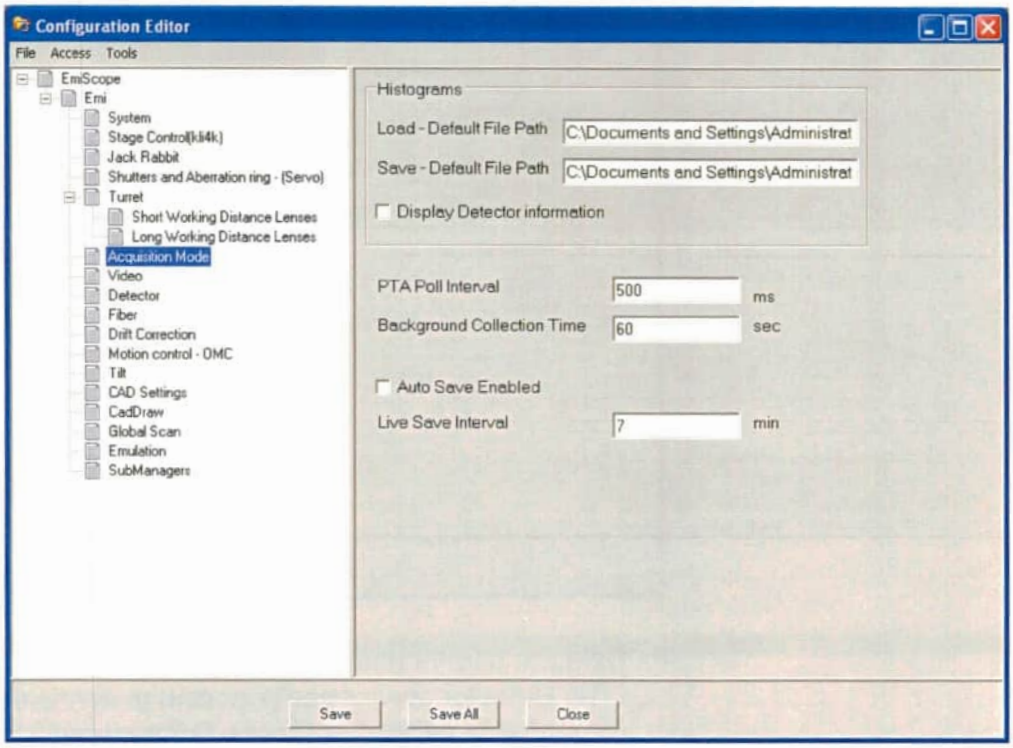
FIGURE 140. Configuration Tool Long Working Distance Lenses Control Panel



6. Acquisition Mode control panel (See Figure 141):
   The Acquisition Mode control panel defines certain parameters for Acquisition mode. 'Histograms Load/Save Default File Path' defines the default disk locations for loading/saving histograms. The 'Display Detector information' check box is a Credence Support function and is for future use. 'PTA Poll Interval' defines the time interval for polling the system electronics during acquisition and should not be changed from the default of 500ms. 'Background Collection Time' defines the acquisition time for collecting the background noise level when using the Noise Filter optional software, see "Noise Filter" on page 135. It is recommended to use the default value of 60 seconds. The 'Auto Save Enabled', when selected, will enable the automatic saving of histograms to a back-up file, and during histogram acquisition, the Live histogram will be automatically saved to a back-up file during the interval defined by 'Live Save Interval'.

Note: Use extreme care if altering Acquisition control parameters. Incorrect settings may cause unpredictable system response or equipment damage. For more information, contact Credence technical support.

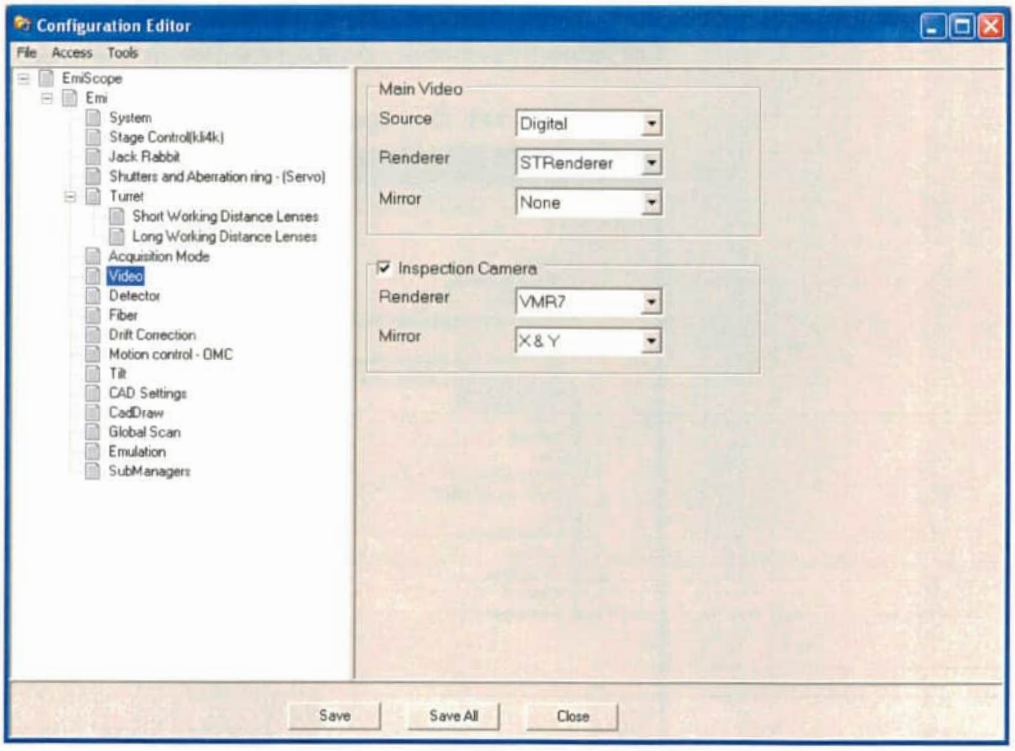
FIGURE 141. Configuration Tool Acquisition Mode Control Panel



7. Video control panel (See Figure 142):
   The Video control panel defined parameters for the main video and inspection camera images in Navigation mode. The settings in the 'Main Video' section and the 'Renderer' setting in the 'Inspection Camera' section should not be altered. The 'Inspection Camera Mirror' setting can be set to rotate/mirror the appearance of the inspection camera view in Navigation mode.

Note: Use extreme care if altering Video control parameters. Incorrect settings may cause unpredictable system response or equipment damage. For more information, contact Credence technical support.

FIGURE 142. Configuration Tool Video Control Panel

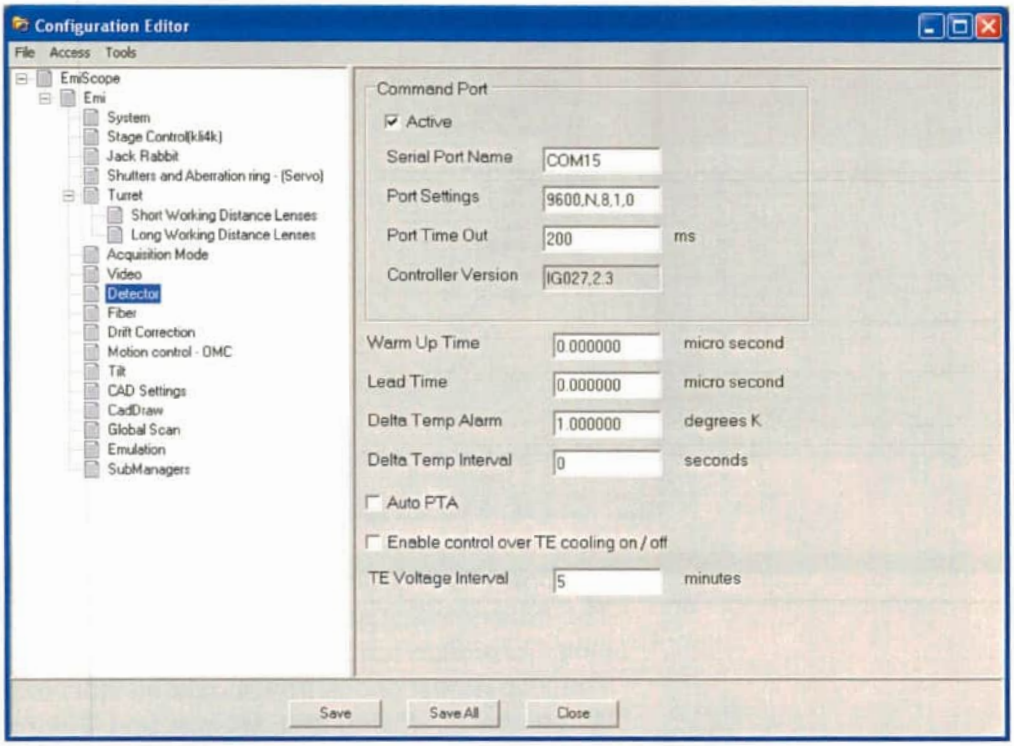


8. Detector control panel (See Figure 143):
   The Detector control panel is used to define communication and control parameters for the EmiScope-II photon detector. The settings in the 'Command Port' section should only be altered by qualified Credence support personnel. The 'Warm Up Time' and 'Lead Time' parameters define the time intervals added to the beginning and end of the time span set in the Acquisition mode Acquisition Settings control panel, see "Acquisition Settings Control Panel" on page 137. The 'Delta Temp Alarm' setting defines the amount of temperature variation allowed, when polling ΔT in Acquisition mode is enabled, before a software warning is displayed. The 'Delta Temp Interval' setting defines the time interval when polling ΔT in Acquisition mode is enabled. The 'Auto PTA' check box, when enabled, sets the pTA Offset and pTA Time Span values, in Acquisition mode, automatically based on the Desired Gate Parameters fields. The 'Enable control over TE cooling on/off' check box, when selected, enables the TE cooler on/off control in the Acquisition Settings control panel. Enabling this control is required to enable/disable the TE cooler from the EmiScope software application. The 'TE Voltage Interval' defines the time span for logging

of TE voltage values via the EmiScope software event logger, see Chapter 8, "Event Logs".

Note: Use extreme care if altering Detector control parameters. Incorrect settings may cause unpredictable system response or equipment damage. For more information, contact Credence technical support.

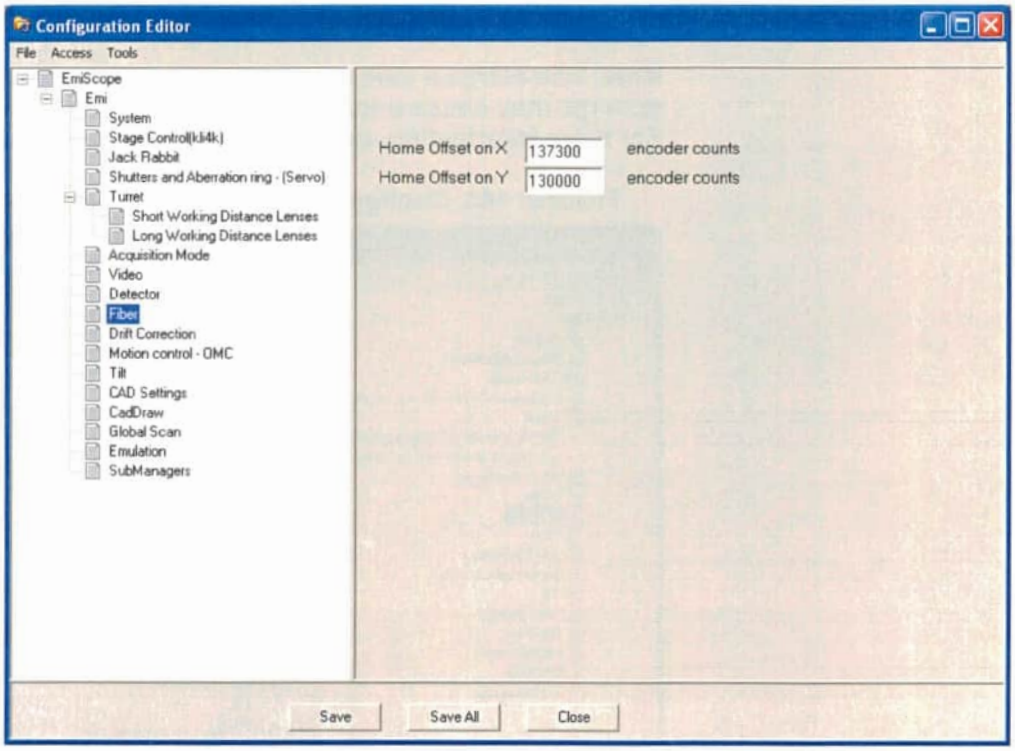
FIGURE 143. Configuration Tool Detector Control Panel



9. Fiber control panel (See Figure 144):
   The Fiber control panel is used to define the limits of the EmiScope-II fiber motors.

Note: Fiber motor controls should only be altered by qualified Credence support personnel. Incorrect settings may cause unpredictable system response or equipment damage. For more information, contact Credence technical support.

FIGURE 144. Configuration Tool Fiber Control Panel

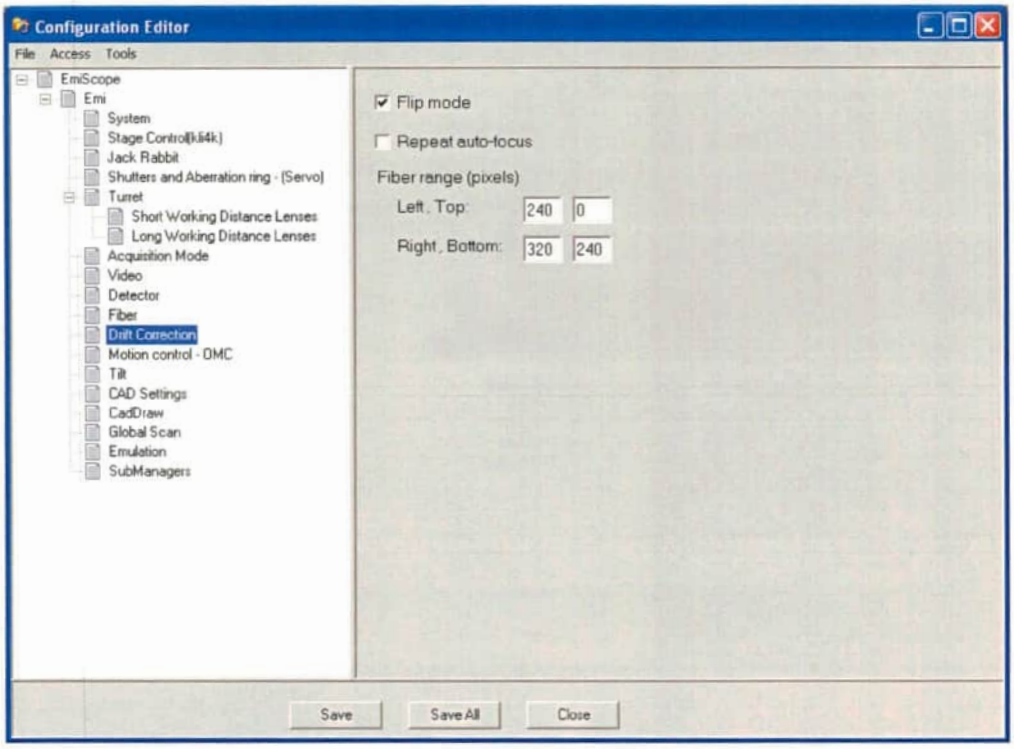


10. Drift Correction control panel (See Figure 145):

    The Fiber control panel is used to define parameters for the Automatic Drift Correction function, see "Automatic Drift Correction" on page 77. The 'Flip mode' check box should be selected for normal usage of ADC. When characterizing drift, unselecting 'Flip mode' is useful to prevent automatic switching of Navigation/Acquisition modes by the ADC algorithm. The 'Repeat auto-focus' check box, when selected, will enable performing the auto focus routine twice, instead of once, when ADC is engaged. The 'Fiber range' defines the limits of fiber motion for the ADC correction. When using ADC and a drift correction is made beyond the 'Fiber range' limits, a software error will be displayed.

Note: Use extreme care if altering Drift Correction control parameters. Incorrect settings may cause unpredictable system response or equipment damage. For more information, contact Credence technical support.

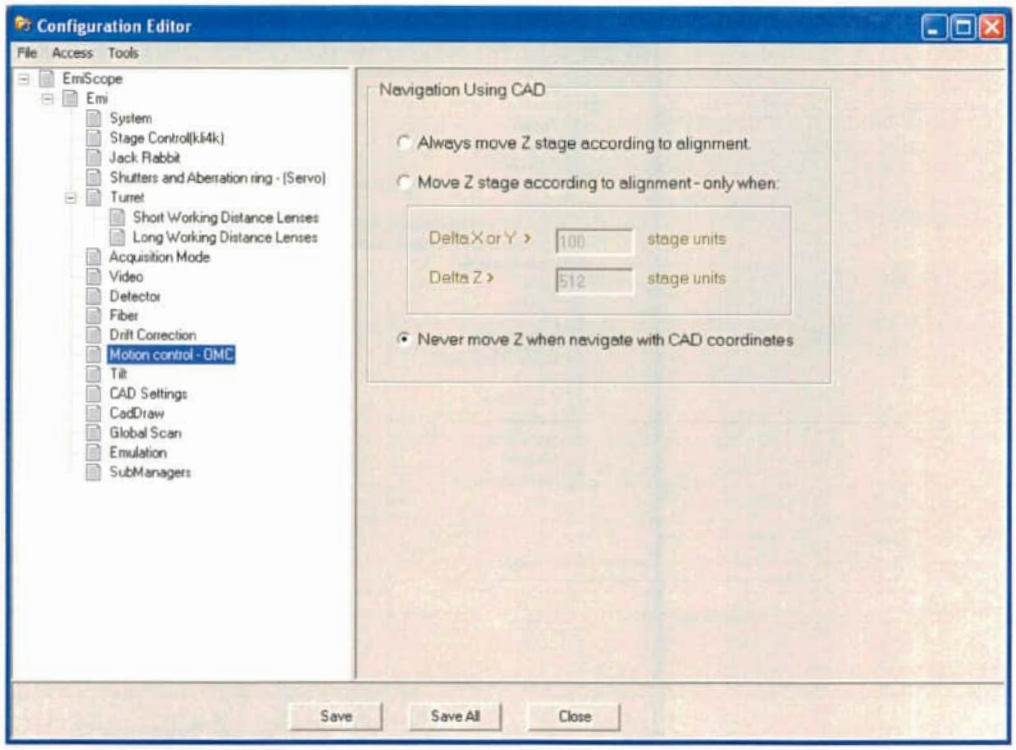
FIGURE 145. Configuration Tool Drift Correction Control Panel



11. Motion control - OMC control panel (See Figure 146):
    The Motion control - OMC control panel is used to define parameters for Z stage movement when navigating via CAD coordinates. The parameter 'Always move Z stage according to alignment', when selected, allows the EmiScope software to automatically implement Z stage movements, based on the 3-point CAD alignment, whenever stage navigation is performed via CAD coordinates. The parameter 'Move Z stage according to alignment - only when', when selected, allows the EmiScope software to automatically implement Z stage movements, based on the 3-point CAD alignment, whenever stage navigation is performed via CAD coordinates and the criteria of 'Delta X or Y / Delta Z' is met. The parameter 'Never move Z when navigate with CAD coordinates', when selected, completely disables automatic Z stage movements.

Note: Use extreme care if altering Motion control - OMC control parameters. Incorrect settings may cause unpredictable system response or equipment damage. For more information, contact Credence technical support.

FIGURE 146. Configuration Tool Motion Control - OMC Control Panel

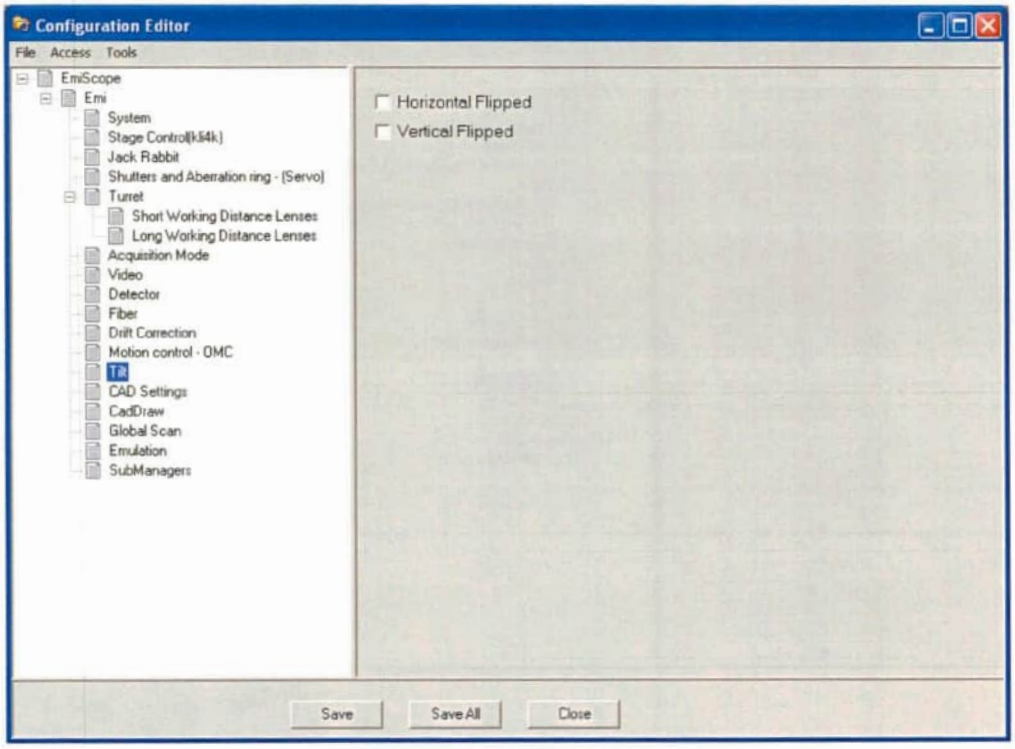


12. Tilt control panel (See Figure 147):

    The Tilt control panel is used to define the direction of movement for the alignment laser when using the Tilt Control Wizard. This is defined at the factory and should not be altered.

Note: Tilt motor controls should only be altered by qualified Credence support personnel. Incorrect settings may cause unpredictable system response or equipment damage. For more information, contact Credence technical support.

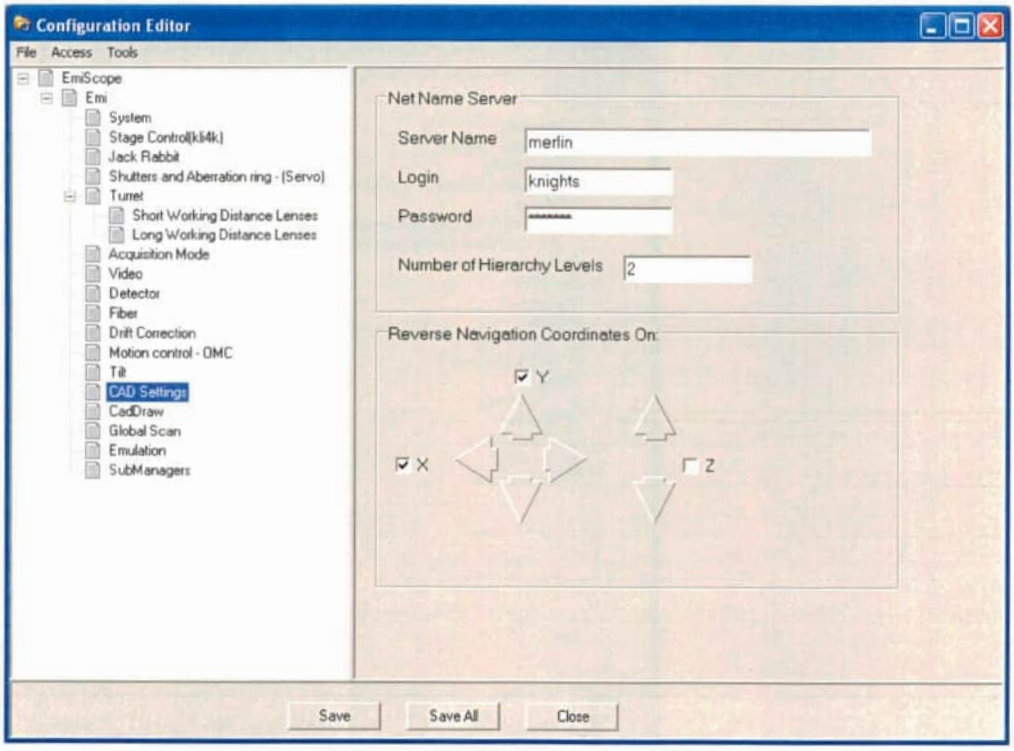
FIGURE 147. Configuration Tool Tilt Control Panel



13. CAD Settings control panel (See Figure 148):
    The CAD Settings control panel has two functions: The 'Net Name Server' section defines the default parameters for automatic naming of histograms with CAD net names, see "Settings Control Panel" on page 139. The 'Reverse Navigation Coordinates On' section allows for reversing the XYZ stage direction movement. This is defined at the factory and should not be altered.

Note: Use extreme care if altering CAD Settings control parameters. Incorrect settings may cause unpredictable system response or equipment damage. For more information, contact Credence technical support.

FIGURE 148. Configuration Tool CAD Settings Control Panel

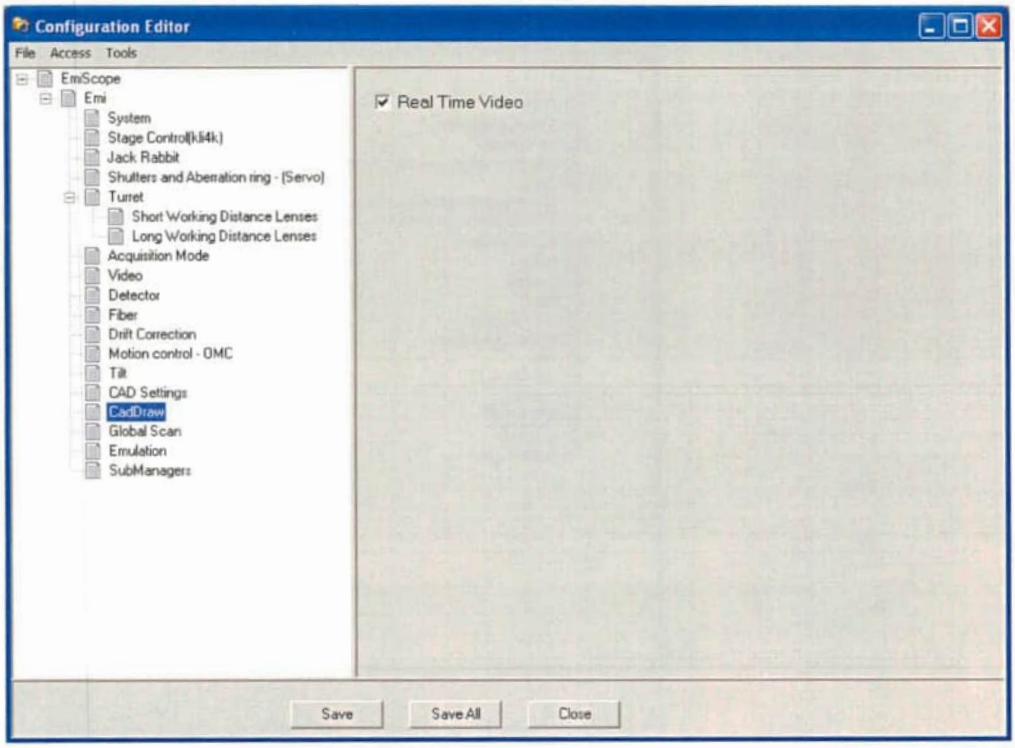


14. CadDraw control panel (See Figure 149):

    The CadDraw control panel is used to define the control mechanism for CAD overlay implementation. This is defined at the factory and should not be altered.

Note: CadDraw controls should only be altered by qualified Credence support personnel. Incorrect settings may cause unpredictable system response or equipment damage. For more information, contact Credence technical support.

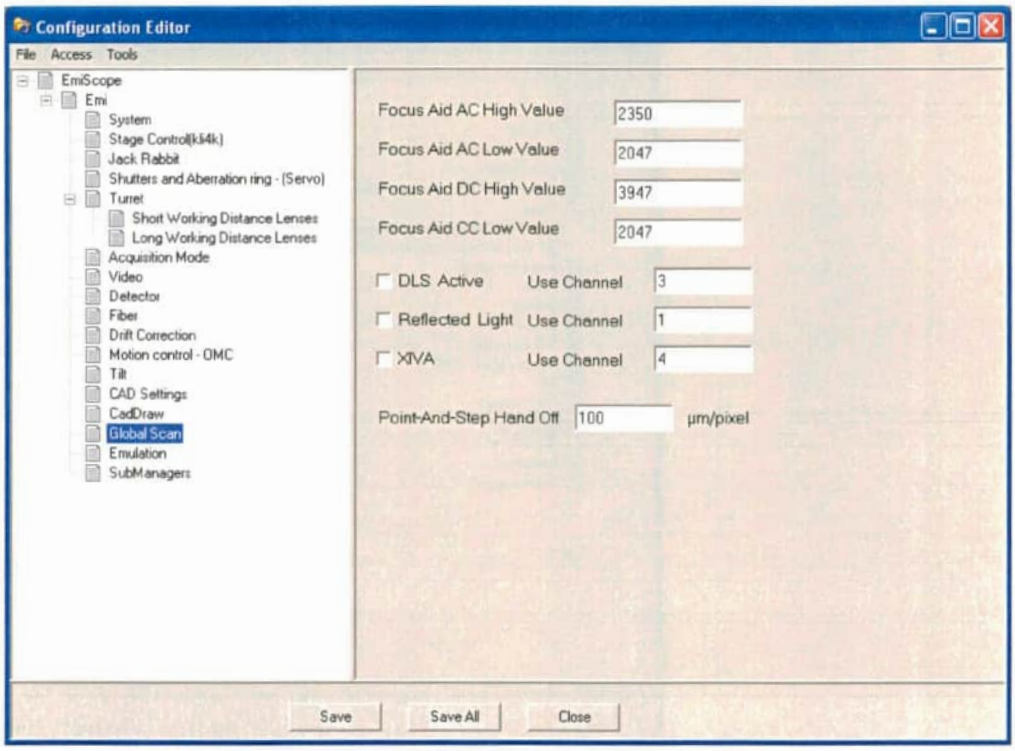
FIGURE 149. Configuration Tool CadDraw Control Panel



15. GlobalScan control panel (See Figure 150):
    The GlobalScan control panel is reserved for future use and should not be altered.

Note: GlobalScan controls should only be altered by qualified Credence support personnel. Incorrect settings may cause unpredictable system response or equipment damage. For more information, contact Credence technical support.

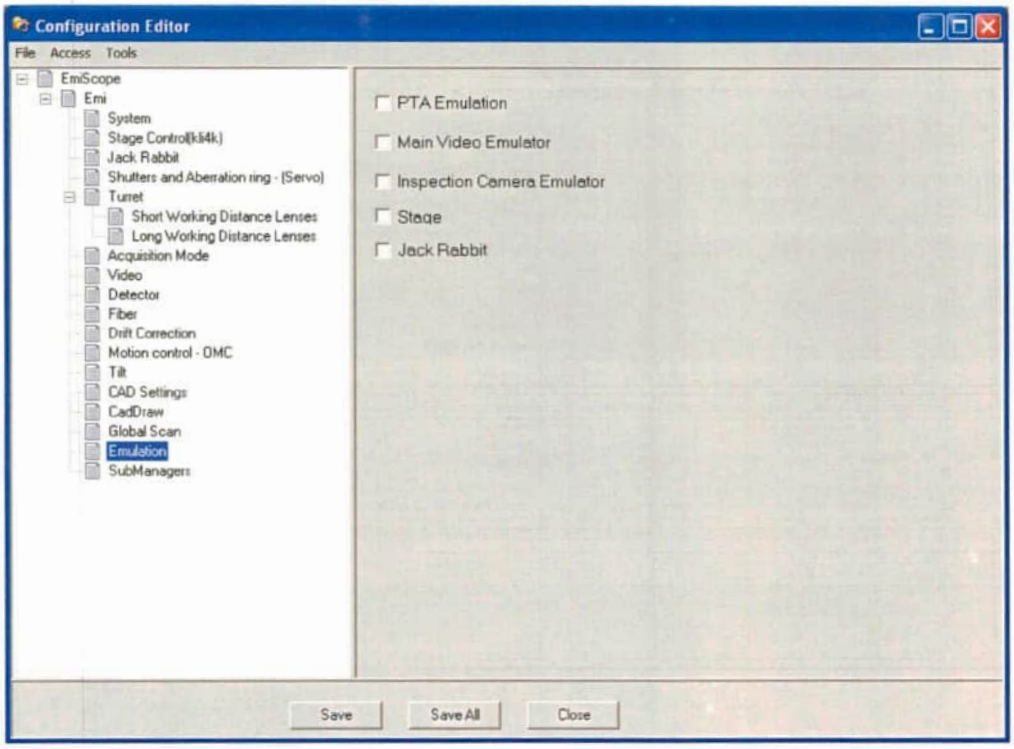
FIGURE 150. Configuration Tool GlobalScan Control Panel



16. Emulation control panel (See Figure 151):
    The Emulation control panel is used to enable software emulation of certain hardware functions and should not be used during normal tool operation.

Note: Emulation controls should only be altered by qualified Credence support personnel. Incorrect settings may cause unpredictable system response or equipment damage. For more information, contact Credence technical support.

FIGURE 151. Configuration Tool Emulation Control Panel

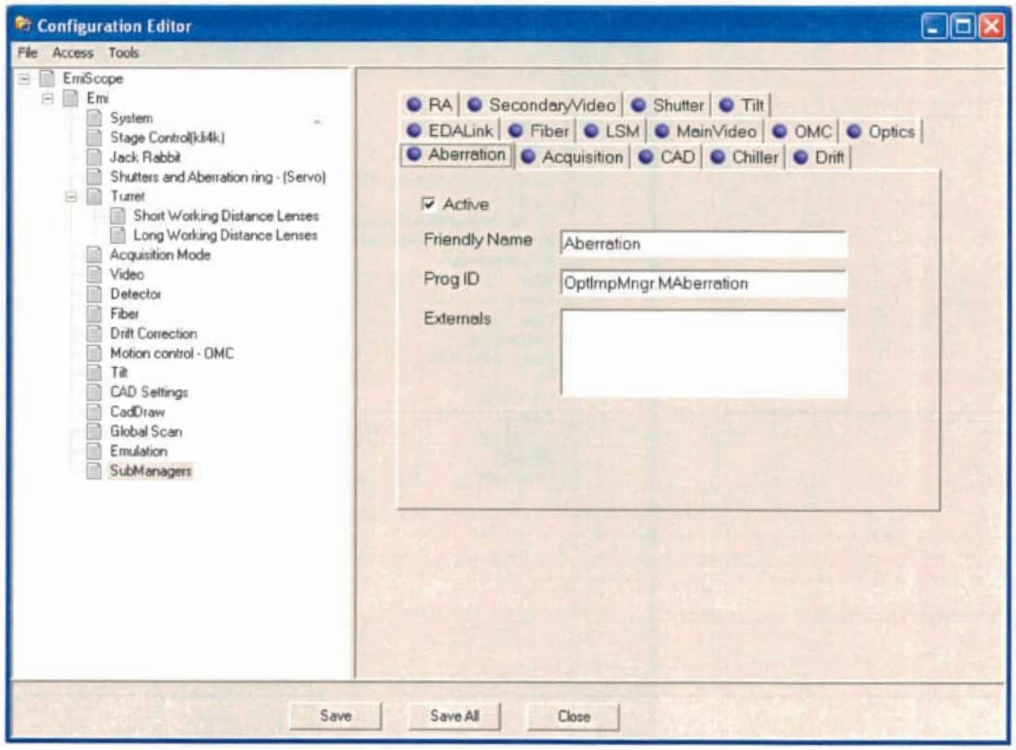


17.SubManagers control panel (See Figure 152):

The SubManagers control panel contains several nested control panels and should not be altered for normal tool operation.

Note: SubManagers controls should only be altered by qualified Credence support personnel. Incorrect settings may cause unpredictable system response or equipment damage. For more information, contact Credence technical support.

FIGURE 152. Configuration Tool SubManagers Control Panel



Configuration Tool Menu Functions

The three menus of Configuration Tool - File, Access, Tools - are summarized below. Access to certain menu items requires enabling Superuser and/or Credence Support.

I. File menu:

The 'Backup/Restore...' menu item allows you to save/restore all of the parameters defined in Configuration Tool.

The 'Import HASP Key Configuration...' allows for redefining the EmiScope-II platform type and software options (see "System control panel (See Figure 134):" on page 219. Requires a new HASP configuration file - contact Credence support.

II. Access menu:

Contains logon controls for Superuser and Credence Support access.

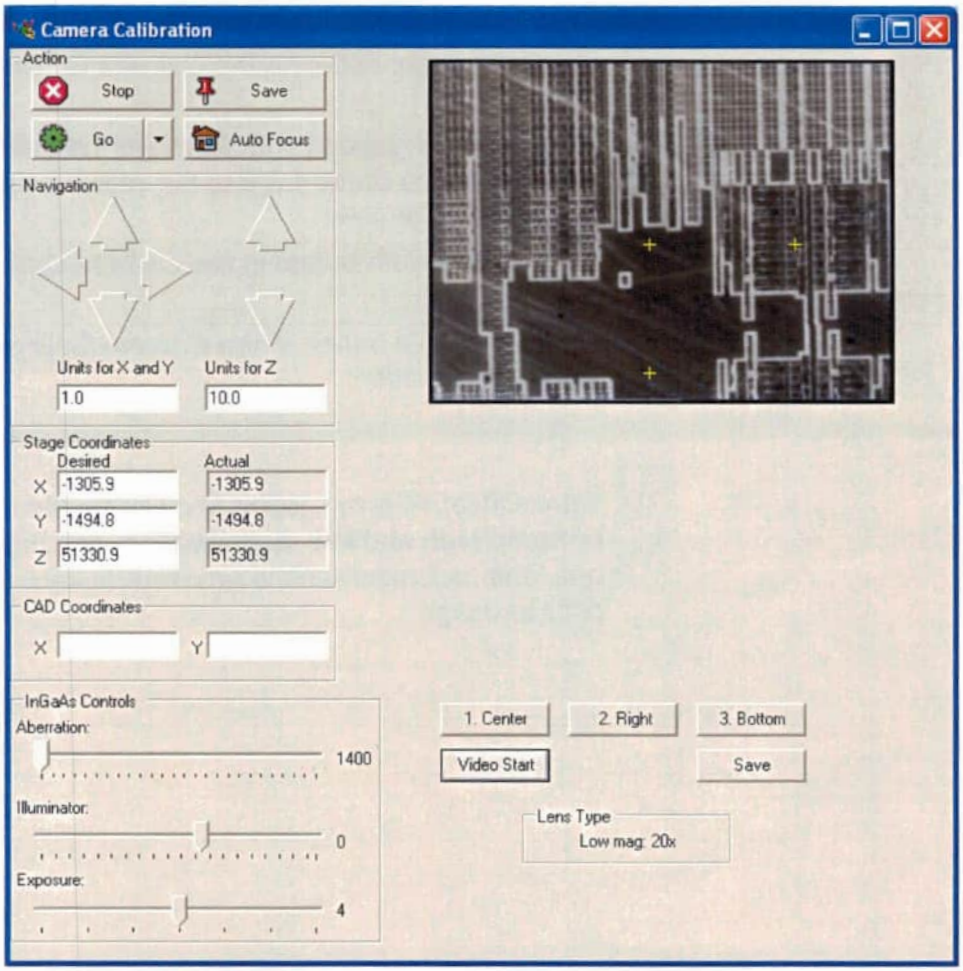
III. Tools menu:

Contains system calibration wizards.

Note: Use extreme care when using the system calibration wizards. Incorrect calibrations may cause unpredictable system response or equipment damage. For more information, contact Credence technical support.

- 'Camera Calibration...' is used to calibrate the DUT image view in Navigation mode, see Figure 153. Camera calibration is a one time calibration and is required for each individual lens on the EmiScope-II prior to usage.

FIGURE 153. Configuration Tool Camera Calibration Wizard



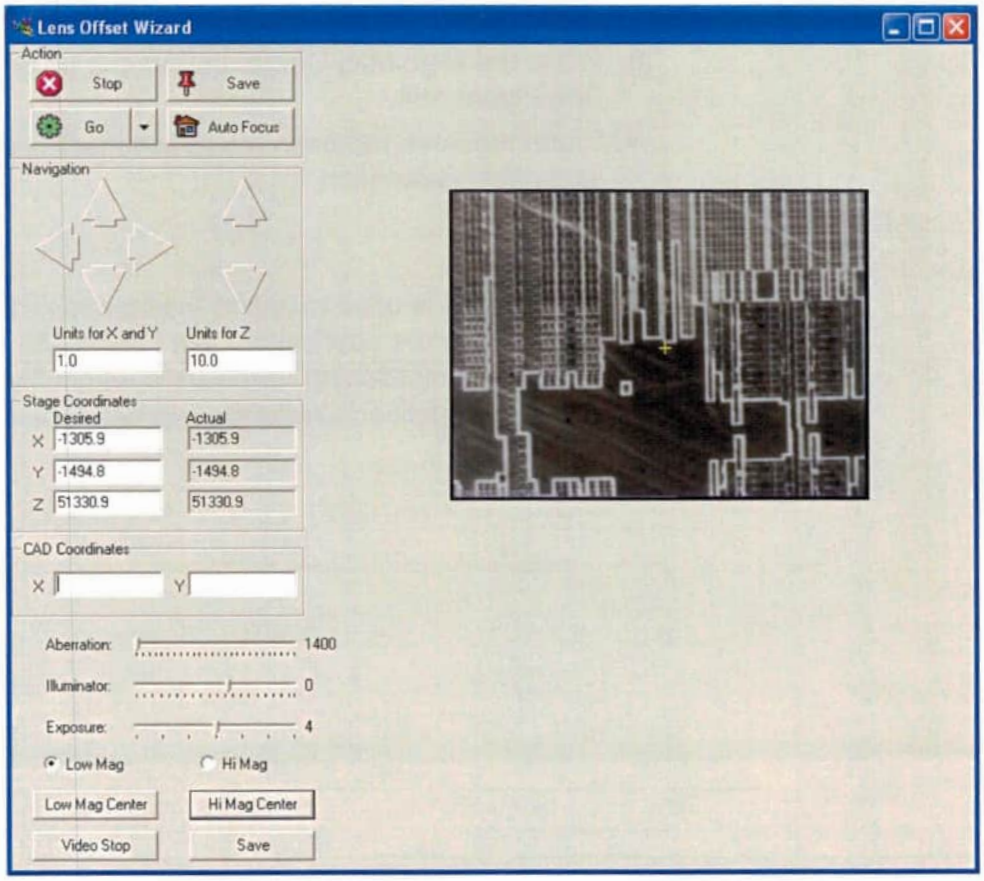
♦ **To use Camera Calibration,**

1. Logon as Superuser.

2. Enable the Camera Calibration wizard from the Tools menu.
3. Using the navigation controls, focus the DUT image.
4. Note the three yellow cross-hairs in the DUT image view. Using the navigation controls, move the DUT image to place a unique, identifiable DUT feature under the yellow cross-hair in the center of the DUT image view.
5. Press the Center button in the Camera Calibration window. See Figure 153.
6. Using the navigation controls, move the same unique, identifiable DUT feature used in Step 4 to the yellow cross-hair on the right side of the DUT image view.
7. Press the Right button in the Camera Calibration window. See Figure 153.
8. Using the navigation controls, move the same unique, identifiable DUT feature used in Steps 4 & 6 to the yellow cross-hair on the bottom side of the DUT image view.
9. Press the Bottom button in the Camera Calibration window. See Figure 153.
10. Press the Save button in the Camera Calibration window to store the camera calibration.

- 'Lens Offset Wizard...' used to calibrate the image offset when switching between high and low magnification, see Figure 154. Lens offset is a one time calibration and is required for each lens set on the EmiScope-II prior to usage.

FIGURE 154. Configuration Tool Lens Offset Wizard



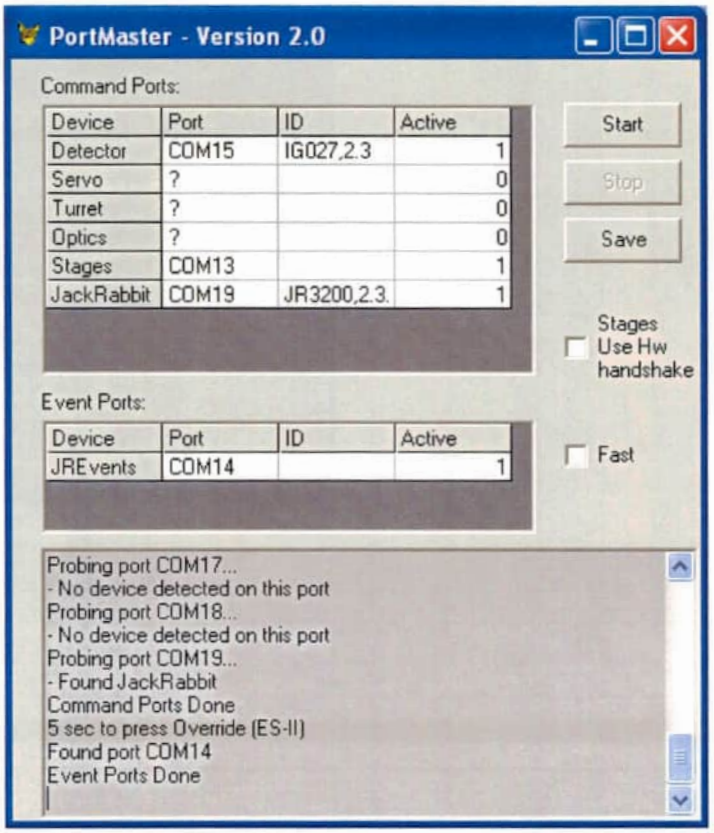
- **To use the Lens Offset Wizard,**

1. Logon as Superuser.
2. Enable the Lens Offset wizard from the Tools menu.
3. Switch to the low magnification lens.
4. Using the navigation controls, focus the DUT image.
5. Using the navigation controls, move the DUT image to place a unique, identifiable DUT feature under the yellow cross-hair in the center of the DUT image view.
6. Press the Low Mag Center button in the Lens Offset Wizard window. See Figure 154.
7. Switch to the high magnification lens.

8. Using the navigation controls, move the same unique, identifiable DUT feature used in Step 5 to the yellow cross-hair in the center of the DUT image view.
9. Press the High Mag Center button in the Lens Offset Wizard window. See Figure 154.
10. Press the Save button in the Lens Offset Wizard window to store the lens offset calibration.

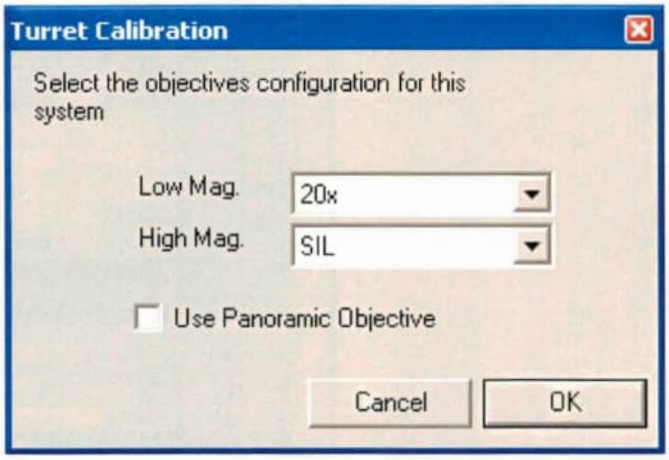
- 'Portmaster' is used to define the communication ports for the EmiScope-II software application, see Figure 155. 'Portmaster' is a one time setting for establishing hardware communication and should only be altered by qualified Credence support personnel.

FIGURE 155. Configuration Tool Portmaster



- 'Turret Configuration...' is used to define the lenses installed in the EmiScope-II turret, see Figure 156. Turret configuration should be used if the EmiScope-II lenses are changed. Changing the turret configuration requires Credence support access. See "Exchanging the EmiScope-II Lenses" on page 179.

FIGURE 156. Configuration Tool Turret Configuration Wizard



Glossary

ATE
Automatic test equipment

DUT
Device under test

FC
Fiber connector

FET
Field effect transistor

FIR
Finite impulse response

NIM
Nuclear Instrumentation Module

Photon counting
The technique of discriminating and counting individual photons, the energy quanta of electromagnetic radiation.

PTA software
picosecond time analyzer

RSS
Root Sum Square

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